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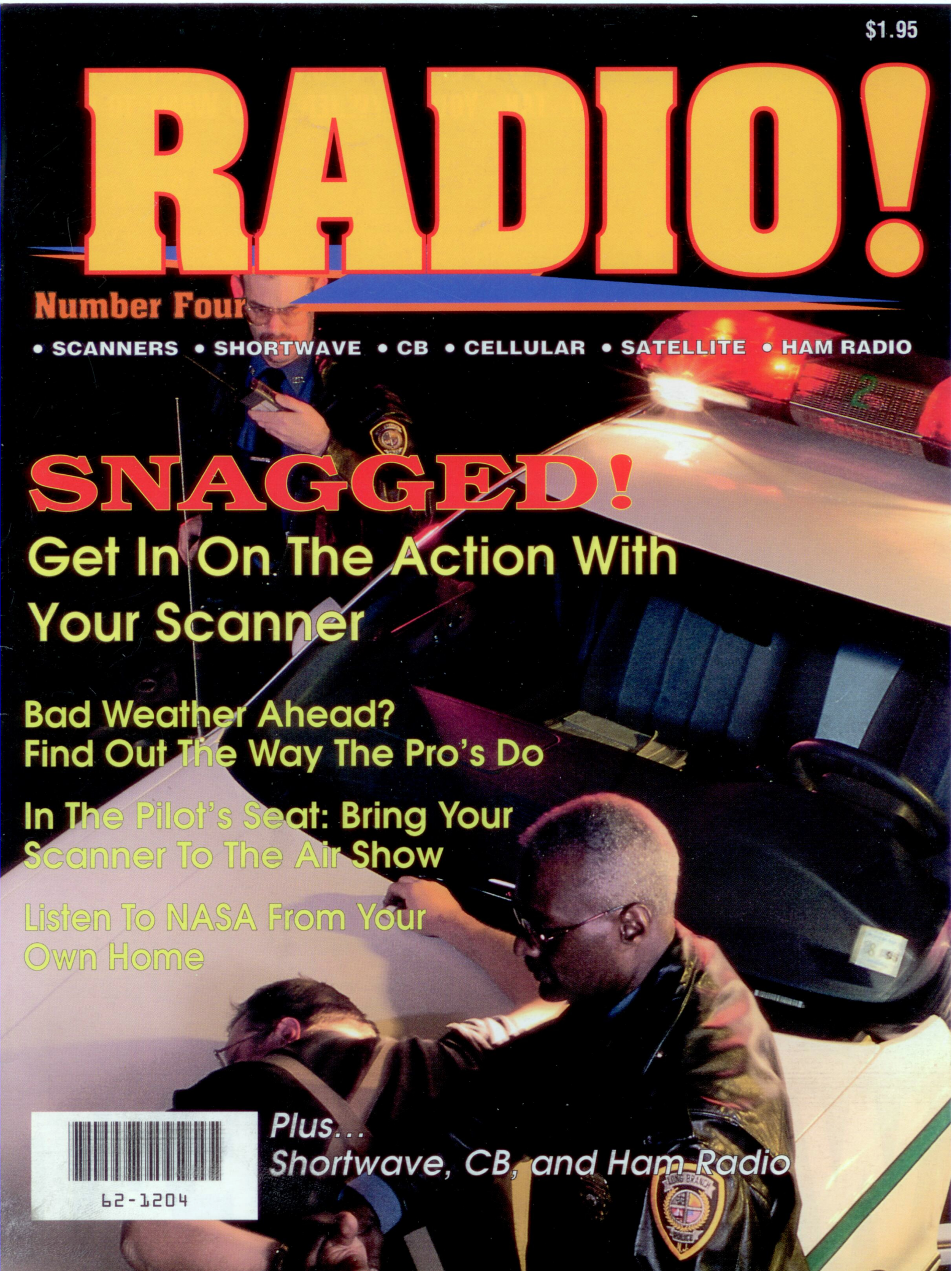

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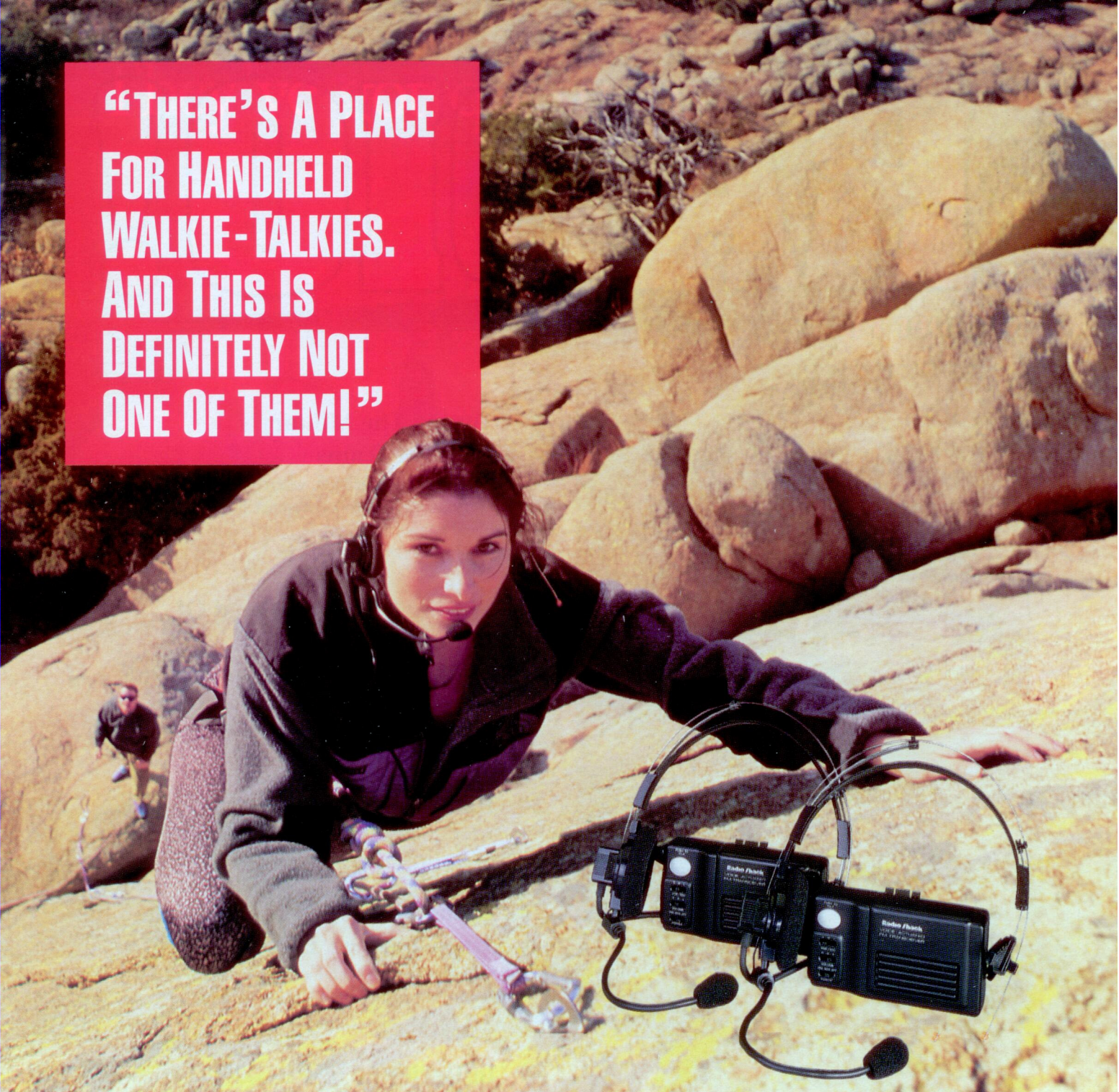

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RADIO!

Number Four

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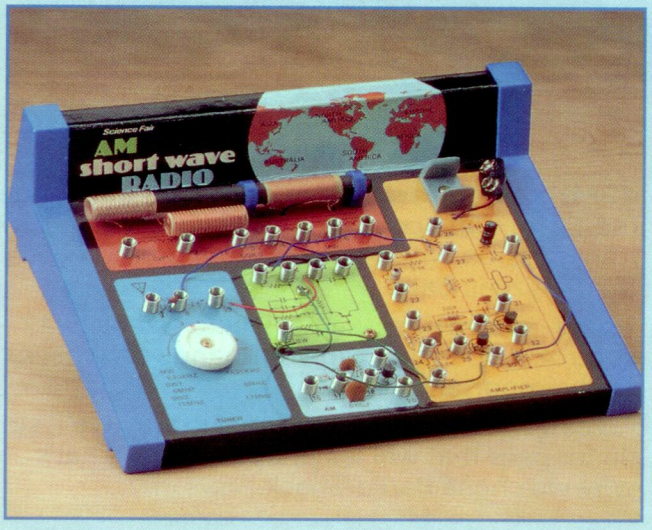

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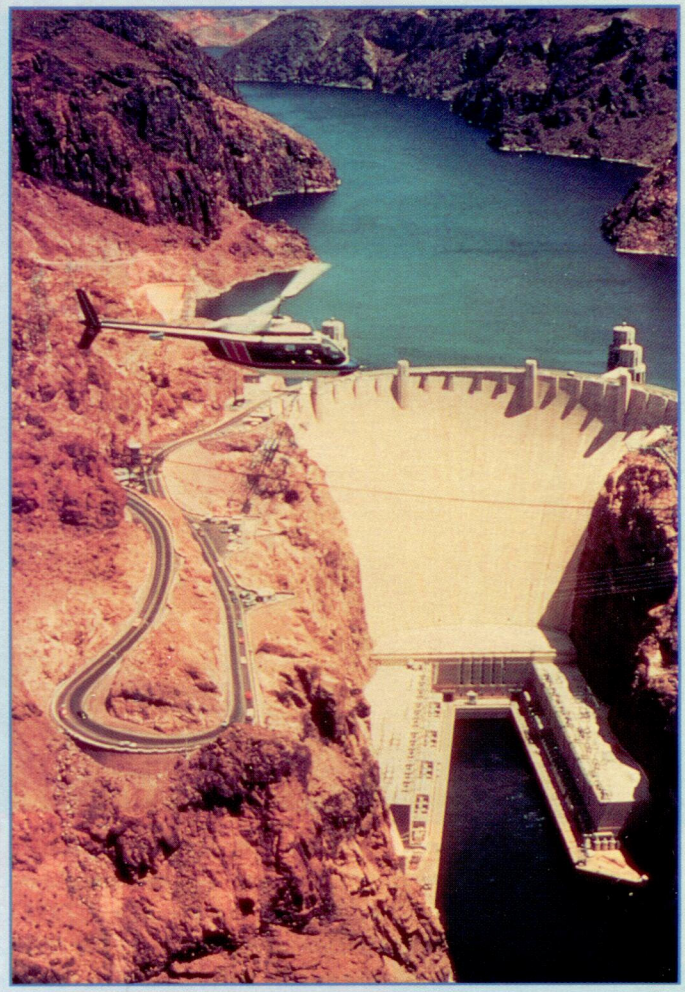

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On the Cover: Two police officers detain a suspect. Photographed with the cooperation of the Long Branch New Jersey Police Department.

It has been a year since the first issue of Radio! *rolled off the presses—Happy Birthday! To celebrate the occasion, Radio Shack will be introducing the new HTX-212 Two-Meter Mobile Radio at the Dayton Hamvention. The HTX-212 is loaded with features that are usually only found in more pricey models. Be sure to see this one if you're a radio hobbyist in the market for a high-quality mobile rig at an affordable price.*

And, if you're a hobbyist, you will probably consider installing an outdoor antenna at some point. You should know that many new real estate developments have a nasty little section in the land deed called "Restrictions and Covenants." This section contains all the restrictions placed on land use, including an onerous line that may say something like, "No antenna of any kind may be constructed or installed on the property." This means that if you buy that building or lot or cute little gingerbread house, you will never be able to legally install an antenna of any kind on the building or the land. Vote with your dollars. If antenna freedom is important to you, tell the developer, "No antenna, no thanks." The same thing goes for apartments, so check the lease first.

We've received lots of very positive mail from our readers over the past year. We try to answer every letter, so please keep them coming. Remember this is your *magazine, tell us what you'd like to read about.*

Thanks for spending a year with us, we hope you will spend many more enjoyable ones with us. 73

Robert B. Miller AA5FL

Vice-President, Radio Shack

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Note: An FCC Amateur Radio License of Technician Class or higher is required to transmit with HTX-202.

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HAM HELD!

Flying in formation, the Blue Angels have been seen by spectators for more than 48 years.

Tuning The Military's Aviation Teams

With flawless precision, where split-second timing is everything, these folks even teach the graceful Bald Eagle a few tricks.

By Harold Ort, N2RLL

You stand in awe by the tarmac. Suddenly, just overhead, seemingly from out of nowhere, comes a deafening roar you'll never forget. Then, in an instant, it's gone. From behind you it comes again and heads straight up this time, where the four Navy F/A-18 Hornets' "vertical break" catches the crowd by surprise. The "ooohs" and "aaahs" tell the rest of the story. This is scanning at its best!

Armed with a handheld scanner, a visit to an airshow represents one of the highlights of scanning during the warmer months. Listening in on the behind-the-scenes communications and air-to-air commo during an airshow is an easy—and safe!—way to experience heart-pounding excitement.

It's always a good idea to have aircraft search limits programmed into your handheld scanner. If you're fortunate enough to have two handhelds, use one with our frequencies programmed into memory and the other to search for additional active frequencies. A pen and note pad come in handy, too, as you join the pilots right there in the cockpits.

A Look at the Teams

The U.S. military has two flight demonstration teams: the Navy's Blue Angels and the U.S. Air Force's Thunderbirds. The Army demonstration team, called the Golden Knights, is a parachute team based at Fort Bragg, North Carolina. These U.S. teams, along with the Canadian Snowbirds, regularly perform aerial demonstrations throughout North America for hundreds of thousands of airshow enthusiasts.

Constant Training

There's more to putting on an airshow than you might think. While the teams practice constantly and remain in top

Countless hours of training go into each Thunderbirds' performance.

The Blue Angels' aircraft, the F/A-18 Hornet, is an impressive sight.

physical condition to endure the rigors of flight—often 7 gs (the measurement of the acceleration of gravity) or more—pre-show coordinators work with show officials, federal authorities, and local organizations to ensure arrangements are followed to the letter.

When the teams aren't flying, they're training. It's all about teamwork, with each squadron working together to put on the safest and most impressive air show possible. One U.S. Navy officer emphasized, "The many tasks involved in putting on the air show include the practice flights, the maintenance personnel preparing the F/A-18s for the flights, and having the parts required to repair the aircraft."

About 100 enlisted Navy and Marine Corps personnel maintain the Blue Angels aircraft and perform other required support roles to present the shows to the public. Their record speaks for itself: In over 48 years of airshows, they have reportedly never canceled a performance because of maintenance difficulties. That's impressive!

Graceful at the Airshow, but They Mean Business!

You don't want to be on the receiving end of one of their aircraft in combat. It can carry up to 17,000 pounds of armament, including two Sparrow III and Sidewinder missiles in nine locations.

Blue Angel planes include a special Heads-Up Display that allows the pilot to keep focused on the target and still be fully informed. New night-equipped Hornets allow flying in all kinds of inclement weather. The Hornet is considered one of the best fighter and attack aircraft there is, largely because of its maneuverability and fast acceleration. Bearing down on enemy positions with lightning speed...well, I think you get the picture!

The Thunderbirds

Like the Blue Angels, the U.S. Air Force Thunderbirds team spends countless hours practicing breath-taking demonstrations. They fly their F-16C Fighting Falcons in precision aerial maneuvers. Smoke-generating systems are installed where a 20mm cannon would be during combat operation. Composed of 140 people, the Thunderbirds team has the same mission it did 42 years ago: "To show Americans their Air Force—its top jets and their capabilities, and the professional men and women it takes to ensure a successful mission."

With a rate of climb of more than 500 feet per second, the Air Force F-16C aircraft used by the Thunderbirds is capable of traveling at twice the speed of sound.

The F-16Cs' maneuverability and combat survival exceed that of all potential threat fighter aircraft. Flying in all types of weather conditions, it can locate targets and detect low-flying aircraft in radar ground clutter. The Iraqi army can attest to the effect of F-16Cs: nearly 250 F-16Cs flew more than 13,000 missions during Operation Desert Storm.

This aircraft can also withstand up to 9 gs. Its avionics systems include a highly accurate inertial navigation system in which a computer provides global positioning and steering information to the pilot. The plane uses UHF and VHF radios, plus an instrument landing system. Its Pratt and Whitney

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Two Golden Knights' jumpers in freefall over Yuma Proving Grounds, Arizona, taken during the team's annual winter training period. (Photo by SFC Gary Winkler, Golden Knights Free-Fall Photographer.)

turbofan engine incorporates the most advanced technology available, and creates a 25,000-pound thrust that enables flying speeds in excess of Mach 2.

In each performance, the Thunderbirds' famous red, white, and blue F-16s perform 30 maneuvers. For about an hour and 15 minutes, combinations of the four-aircraft diamond, five-aircraft special formations, and six-aircraft delta formation, with the single- and two-aircraft solos are demonstrated. While no more than 88 air demonstrations are performed each year, the team travels more than 200 days annually. Like the Blue Angels, the Thunderbirds also boast never having canceled a performance because of maintenance difficulties.

Based at Nellis Air Force Base in Nevada, the Thunderbirds have been seen by nearly 275 million people in all 50 states and 55 foreign countries since their inception in 1953. In all, they've accomplished over 3,300 aerial demonstrations!

A Look at the Snowbirds

The Canadian Armed Force's aerobatics team, the Snowbirds, was formed in 1971 in Saskatchewan. Forerunners of the Snowbirds were the Golden Hawks and Golden Centennaires. The Snowbirds received world-wide recognition for many years as the only nine-plane aerobatics flight demonstration team outside Europe. Annually, their CT-114 Tutor jets thrill thousands at more than 75 airshows in North America, and it was also the first North American demonstration team to fly a show north of the Arctic Circle. Previously operating on a year-to-year basis, largely because of limited funds, the year 1978 was an important milestone

Blue Angels Frequencies (all AM and in MHz)

121.9	143.0	250.8	275.35	384.4
141.56	143.6	251.6	305.9	391.9
142.0	238.15	263.35	319.8	395.9
142.025	241.4	263.50	360.4	

Thunderbirds Frequencies (AM unless otherwise noted and in MHz)

120.45	148.55	250.85	295.7	382.9
126.2	235.25	273.5	302.15	394.0
140.4	236.55	275.35	322.3	413.0 (FM)
141.85	236.6	283.5	322.6	413.025 (FM)
142.0	241.4	294.7	322.95	413.1 (FM)

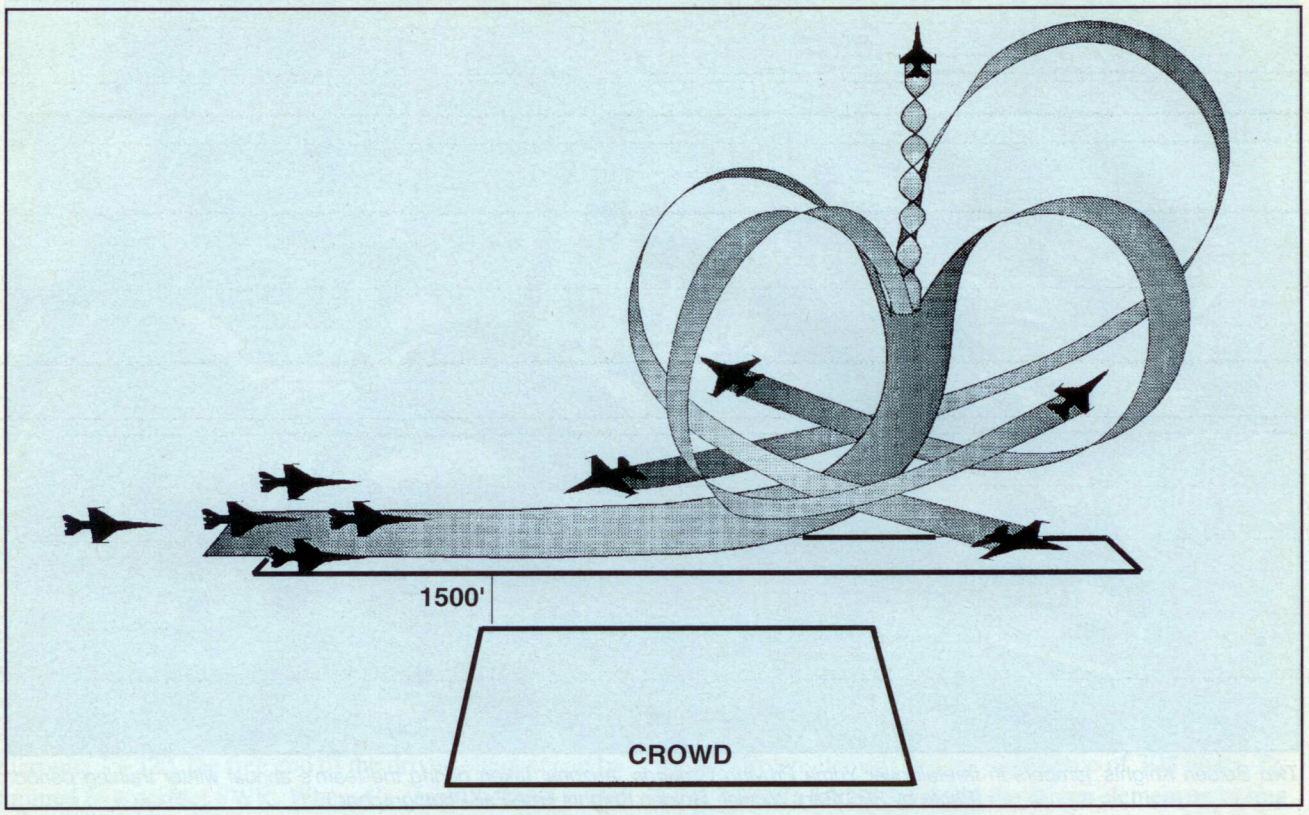
U.S. Army Golden Knights Frequencies (AM unless otherwise noted and in MHz)

32.30 (FM)	123.425
42.35 (FM)	123.475 (Primary freq.)
123.4	

Snowbirds Frequencies (all AM and in MHz)

F1	275.8	F9	294.5	F17	363.8	F25	321.7
F2	295.6	F10	322.8	F18	289.4	F26	344.4
F3	310.8	F11	245.7	F19	245.0	F27	356.6
F4	227.6	F12	316.5	F20	239.8	F28	236.8
F5	243.4	F13	344.5	F21	278.8	F29	282.8
F6	240.5	F14	356.6	F22	227.65	F30	245.5
F7	378.5	F15	236.6	F23	266.31	F31	239.9
F8	266.3	F16	283.9	F24	294.7	F32	299.9

Air-to-air: 141.85; Ground crew: 413.025(FM); Emergency: 381.8



This drawing of the "High Show Bomb Burst" by the Thunderbirds shows why communications on the aircraft bands are so crucial.

in their history: on April 1 of that year they were established as a permanent squadron.

A major highlight of their shows was their demonstration in 1988 at the opening ceremonies of the Winter Olympic Games in Calgary, Alberta, where the team's performance was seen by almost two billion people around the world. The Snowbirds had another historic year in 1993; it was the first time the team performed outside Canada and the U.S.

This year Major Steve Hill of Bobcaygeon, Ontario, will lead the team to 80 scheduled performances at 55 different locations all across North America. Their aim remains the same as it has been for years: to demonstrate the Canadian Forces' skill, professionalism, and teamwork to the North American public.

The Army's Golden Knights

Most folks wouldn't consider jumping out of any kind of aircraft, especially when the pilot can land the machine. But, thankfully, there are many brave souls who parachute for a living. We're talking about the U.S. Army Parachute Team, the Golden Knights.

The Knights have performed over 7,000 live aerial demonstrations in the U.S. and 45 foreign countries. Since their inception in 1959 at the "Home of the Airborne," Fort Bragg, North Carolina, their aerobatics skills have been seen by more than 20 million spectators. The team has more than 1,200 parachute jumps under its belt. The average Golden Knight is 26-years-old and a member of one of two Knights' teams: the Black or Gold team.

Flying at almost two and a half miles above the show site, the teams' C-31A Friendship aircraft seemingly inch across the sky. The ground narrator excitedly announces, "Jumper away," and the famous trail of red smoke from the canister attached to the jumper's boot paints a picture overhead. Reaching speeds in excess of 150 mph, this is the only way to track the jumper as he or she accelerates through the sky. At 2,000 feet the parachute deploys the team's distinctive black and gold main parachute. Like a giant eagle swooping in on the target—a large orange "X" at the center stage—the chute is maneuvered to touchdown!

The same degree of precision, teamwork, and discipline exhibited by the aircraft aerial demonstration teams is evident with the Golden Knights. They'll be quick to tell you that putting on a show like this is the culmination of months of continuous physical training and camaraderie. Even the "Friendship" aircraft of the Golden Knights takes part in the show. After the jumpers have exited the plane, the C-31A will often descend and perform a low-altitude, high-speed flyby, demonstrating the maneuverability and versatility of the aircraft.

One lucky, and adventurous, former Army journalist, Susan McKenzie, was treated to a ride in the C-31A. She vividly recalls the adventure, saying, "Wind gushed past me through the airplane's open door. I thought I would freeze my fingers blue, they were so cold. However the view outside looked beautiful—the blue sky, white wisps of clouds, and the green patchwork of the ground below us."

Golden Knights in freefall over the North Carolina countryside. (Photo by Sgt. Jake Brown.)

Explaining the actual jump, she added, "They gave the 'high-five' handshake to each other, then two of the men in black headed toward the open door. The first stepped into the air, smiled, and saluted as he slipped away. The second followed. I leaned over as far as the seat belt would allow and saw the gold and black parachutes dance below."

It's quite a view wherever you are—in the plane or as a spectator on the ground. Look at their schedule this season and "Be All that You Can Be" by experiencing the thrill of the Golden Knights.

For specific show information, consult your local newspaper or radio station. ■

Scanning at its Best!

Once you listen to the behind-the-scenes communications and air-to-air commo during an airshow, you'll have a real appreciation for what it takes to be a member of the Blue Angels, Thunderbirds, Snowbirds, or Golden Knights. Pack your scanner, bring extra fresh batteries, and enjoy the show.

1995 Blue Angels Air Show Schedule

March	25-26	Mesa, AZ
April	1-2	Sanford, FL
April	8	Marine Corps Air Station, Cherry Point, NC
April	22-23	MacDill AFB, FL
April	28-30	Marine Corps Air Station, El Toro, CA
May	6-7	Naval Air Station, Lemoore, CA
May	13-14	Naval Air Station, Meridian, MS
May	20-21	Fort Smith, AR
May	27	Naval Air Station, Patuxent River, MD
May	29	U.S. Naval Academy, MD
June	3-4	Detroit, MI
June	10-11	North Kingstown, RI
June	17-18	Oklahoma City, OK
June	24-25	Philadelphia, PA
July	1-2	Redding, CA
July	8-9	Bushell Park, Canada
July	15-16	Hillsboro, OR
July	22	Pensacola Beach, FL
July	29-30	Kansas City, MO
August	5-6	Columbus, OH
August	12-13	Dubuque, IA
August	19-20	Reading, PA
August	25-27	Naval Air Station, Miramar, CA

Sept	2-3	Naval Air Station, Barbers Point, HI
Sept	9-10	Naval Air Station, Whidbey Island, WA
Sept	16-17	Smyrna, TN
Sept	23-24	Naval Air Station, Oceana, VA
Sept	30	Alexandria, LA
Oct	1	Alexandria, LA
Oct	7-8	San Francisco, CA
Oct	14	Naval Air Station, Fallon, NV
Oct	21-22	Houston, TX
Oct	28-29	Sheppard AFB, TX
Nov	4-5	Naval Air Station, Cecil Field, FL
Nov	10-11	Naval Air Station, Pensacola, FL

1995 USAF Air Demonstration Squadron Thunderbirds Schedule

April	1	Eglin AFB, FL
April	2	Patrick AFB, FL
April	8	Luke AFB, AZ
April	9	Vandenberg AFB, CA
April	22-23	Loveland, CO
April	29-30	McGhee Tyson Army National Guard Base, TN
May	6-7	Ft. Lauderdale, FL
May	13	Randolph AFB, TX
May	14	Reese AFB, TX
May	20-21	Andrews AFB, MD
May	27-28	Columbia, MO
May	31	USAF Academy, CO
June	3	Holloman AFB, NM
June	4	Durango, CO
June	10-11	Hanscom AFB, MA
June	14	Whiteman AFB, MO
June	17-18	Hamilton, Canada
June	24-25	Davenport, IA
July	2-4	Battle Creek, MI
July	8	Grand Forks AFB, ND
July	9	Ellsworth AFB, SD
July	15-16	Springfield, IL
July	22-23	Naval Air Station, Brunswick, ME
July	26	Cheyenne, WY
July	29-30	Scott AFB, IL
August	5-6	Chicago, IL
August	19	Hill AFB, UT
August	20	Bozeman, MT
August	26-27	Frederick, MD
Sept	3-4	Offutt AFB, NE
Sept	9-10	Toledo, OH
Sept	16-17	Roswell, NM
Sept	23-24	Liberal, KS
Sept	30	Salinas, CA
Oct	1	Salinas, CA
Oct	7	Langley AFB, VA
Oct	8	Charleston AFB, SC
Oct	14-15	March AFB, CA
Oct	21-22	El Paso, TX
Oct	25	Keesler AFB, MS
Oct	28-29	Naval Air Station, New Orleans, LA
Nov	4-5	Daytona Beach, FL
Nov	11-12	Homestead AFB, FL

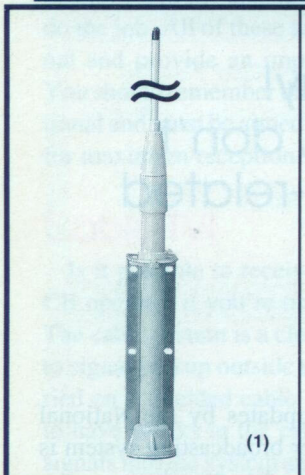
1995 U.S. Army Parachute Team Golden Knights Schedule

April	1	Eglin AFB, FL
April	2	Patrick AFB, FL
April	8	Luke AFB, AZ
April	9	Vandenberg AFB, CA
April	9	Barksdale AFB, LA
April	22-23	MacDill AFB, FL
April	23	Monroe, LA
April	29-30	Knoxville, TN
May	6-7	Ft. Lauderdale, FL
May	7	Benton Harbor, MI
May	13-14	Salisbury, NC
May	13	Randolph AFB, TX
May	14	Reese AFB, TX
May	18	Fort Meade, MD
May	19-21	Andrews AFB, MD
May	20	Fort Smith, AR
May	23	Manassas, VA
May	27-28	Columbia, MO
May	27	Naval Air Station, Patuxent River, MD
May	29	Andover, MA
June	3-4	Detroit, MI
June	3-4	Myrtle Beach, SC
June	10-11	Plattsburgh AFB, NY
June	10-11	Kalamazoo, MI
June	11	Fayetteville, NC
June	14	Whiteman AFB, MO
June	17-19	North Webster, IN
June	20	Grand Rapids, MI
June	24-25	Davenport, IA
June	24-25	Niagara Falls, NY
July	4	Ft. Bragg, NC
July	8-10	White Lake, NY
July	8	Malmstrom AFB, MT
July	9	Ellsworth AFB, SD
July	15-16	Springfield, IL
July	15-16	Van Nuys, CA
July	22-23	Dayton, OH
July	29-30	Kansas City, MO
July	30	Minot AFB, ND
August	4	Ft. Eustis, VA
August	5-6	Columbus, OH
August	5-6	Chicago, IL
August	12-13	Dubuque, IA
August	12-13	Fargo, ND
August	19-20	Reading, PA
August	20	Bozeman, MT
August	21-24	Gray, TN
August	26-27	Medford, OR
August	28	Evansville, IN
August	30-Sept 5	Oahu, HI
Sept	2-4	Louisville, KY
Sept	9-10	Whidbey Island, WA
Sept	9-10	Toledo, OH
Sept	16-17	Dallas, TX
Sept	16-17	Roswell, NM
Sept	23-24	Fresno, CA
Sept	27	Grand Junction, CO
Sept	30	Athens GA
Sept	29-Oct 2	Dallas, TX

Oct	7-8	Travis AFB, CA
Oct	7-8	Fort Worth, TX
Oct	14-15	March AFB, CA
Oct	14	Naval Air Station, Fallon, NV
Oct	21-22	El Paso, TX
Oct	25	Keesler AFB, MS
Nov	4-5	Daytona Beach, FL
Nov	4-5	Naval Air Station, Cecil Field, FL
Nov	11-12	Homestead, FL

1995 Snowbirds Air Demonstration Schedule

April	27	Hay River, NT
April	29-30	Juneau, AK
May	3	Penticton, BC
May	5	Brandon, NB
May	9	Duluth, MN
May	11	Lloydminster, SK
May	13-14	Kelowna, BC
May	20-21	Sault Ste Marie, ON
May	22	Chapleau, ON
May	27-28	Mirabel, QC
May	30	St. John, NB
June	1	Mont-Laurier, ON
June	6	Bromont, QC
June	8	Grand Bend, ON
June	10	Leamington, ON
June	11	Windsor, ON
June	16	Canadian Forces Base, Goose Bay, NF
June	18	Canadian Forces Base, Gander, NF
June	20	Summerside, PE
June	22	Sept-Iles, QC
June	24-25	Ottawa, ON
June	27	Charlevoix, QC
June	29	Shediac, NB
July	2-3	Canadian Forces Base, Borden, ON
July	5	Grand Beach, NB
July	8-9	Canadian Forces Base, Moose Jaw, SK
July	15-16	Calgary, AB
July	17	Slave Lake, AB
July	19	Prince Rupert, BC
July	22-23	Prince George, BC
July	25	Whitehorse, YK
July	27	Cranbrook, BC
July	29-30	Victoria, BC
August	2	Prince Albert, SK
August	5-6	Red Deer, AB
August	7	Grande Prairie, AB
August	9	Kamloops, BC
August	11-13	Abbotsford, BC
August	19-20	Quebec, QC
August	23	La Tuque, QC
August	26-27	Canadian Forces Base, Shearwater, NS
August	29	Yarmouth, NS
Sept	2-4	Toronto, ON
Sept	6	Thunder Bay, ON
Sept	9-10	Portage la Prairie, NB
Sept	15-17	Reno, NV
Sept	20	Peterson AFB, CO
Sept	23-24	NAWS Point Mugu, CA
Sept	30-Oct 1	Midland, TX
Oct	3	San Angelo, TX
Oct	7-8	Page, AZ
Oct	14	Canadian Forces Base, Moose Jaw, SK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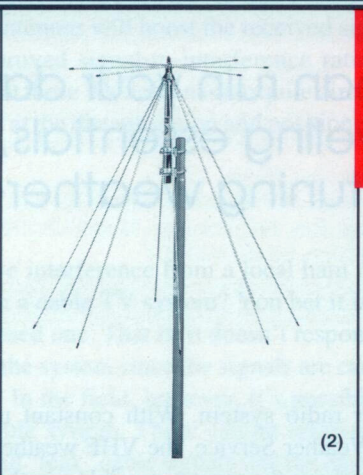
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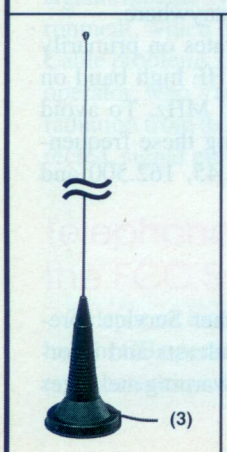
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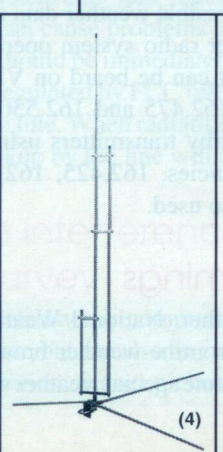
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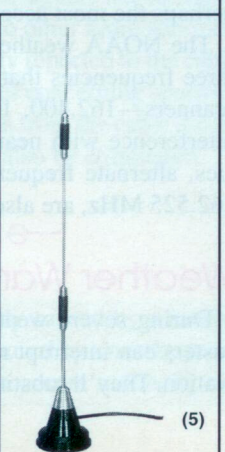
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(3) ⅝"-Wave Magnetic-Mount Mobile 2-Meter Antenna. Take your 2-meter handheld on the road! No holes to drill—holds securely to roof, hood or trunk top at highway speeds. 16-foot cable. **#19-210**..... **39.99**

(4) All-Band Scanner Roof Antenna. Three vertical, three radial elements combine to bring in more frequencies more clearly. Accepts PL-259 connector. **#20-014** **29.99**

(5) Magnetic-Mount Mobile Scanner Antenna. Has 16-foot cable with Motorola-type plug. **#20-012** **29.99**

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You've got to do some fast tuning to keep alert during severe thunderstorms, like this one in Texas. (Photo by Jim Leonard.)

Staying One Step Ahead Of Mother Nature

Bad weather can do more than ruin your day! So, along with your other traveling essentials, don't forget to pack your radio for tuning weather-related information.

By Chuck Gysi, N2DUP

No matter where you are or what time of year it is, few factors will affect plans as much as the weather. Bad spring and summer weather can ruin vacations or weekend trips, or worse. In the case of tornadoes and hurricanes, for instance, it can cause severe damage. Fall flooding and winter snowfalls cause havoc, too. While you could wait around for the happy-talk meteorologist on the evening TV news, you can also get instant weather on demand with your radio and stay one step ahead of Mother Nature.

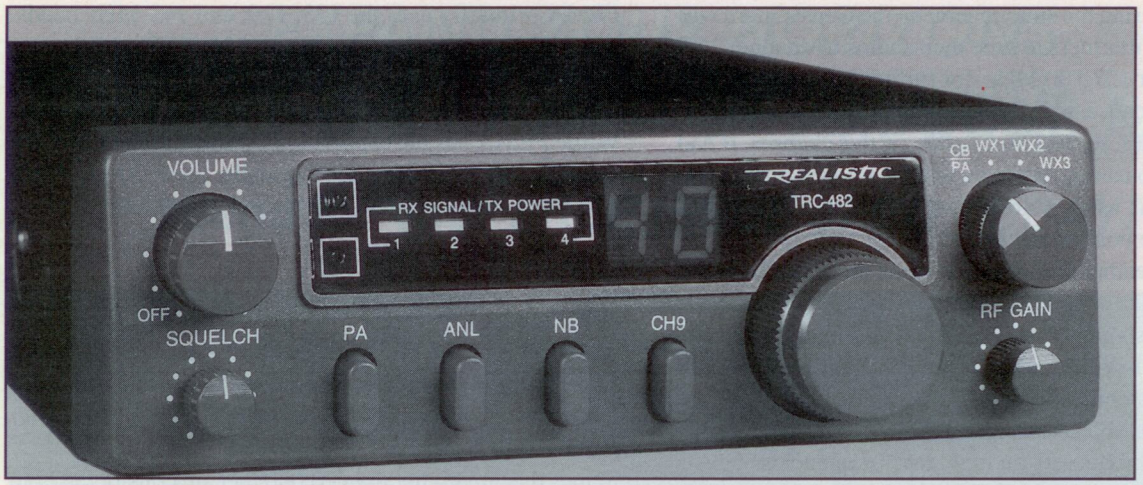
VHF Weather Broadcasts

If you own a scanner, you probably already know about the easiest source of weather information—the National Oceanic and Atmospheric Administration's (NOAA) weather radio system. With constant updates by the National Weather Service, the VHF weather broadcasting system is perhaps the most accessible weather data anywhere.

The NOAA weather radio system operates on primarily three frequencies that can be heard on VHF high band on scanners—162.400, 162.475 and 162.550 MHz. To avoid interference with nearby transmitters using these frequencies, alternate frequencies, 162.425, 162.45, 162.500 and 162.525 MHz, are also used.

Weather Warnings

During severe weather, National Weather Service forecasters can interrupt routine weather broadcasts and information. They'll substitute special weather warning messages



Some CB radios, like the TRC-482 from Radio Shack, offer the ability to tune NOAA reports with the touch of a button...

or information on other impending or actual disasters, such as toxic gas spills, nuclear power accidents, etc. The forecasters can activate specially-designed warning receivers by transmitting a 10-second, 1,000-Hertz tone to get their listeners' attention. While some radio receivers will not respond to the alert tone, other more expensive models will set off an alarm on the radio itself when the tone is received.

There are also specially-designed weather receivers. These VHF high-band radios allow tuning in the 162-MHz band for the weather broadcasts. More expensive models will include the weather alerting feature so that your receiver remains silent until the National Weather Service activates the alert tone. Some are even equipped with a flashing red light to tell you that there was a weather alert in your absence.

NOAA weather radio broadcasts usually can be heard up to 40 miles from the transmitter site. Most stations transmit with a power of 500 or 1,000 watts.

Updated Forecasts

Meteorologists at the National Weather Service forecast offices around the country provide the "programming" for NOAA transmitters. Each city's weather transmitter broadcasts are usually custom-tailored for that area, although there are some transmitters that repeat the signal of a stronger station into a fringe area.

Taped weather messages are repeated every four to six minutes and are routinely revised every one to three hours, or more frequently if needed. Most of the weather transmitters are on the air 24 hours a day, 365 days a year.

Under a 1975 policy statement issued by the White House, the NOAA weather network was designated the sole government-operated radio system authorized to provide warnings of natural disasters and nuclear attacks directly into private homes. Of course, this capability is supplemented on a local basis by sirens and commercial radio and TV broadcasts.

There are more than 380 weather transmitters on the air across the country, and about 90 percent of the nation's population is within listening range of an NOAA transmitter.

...Or, you can choose a desktop radio to monitor the latest weather conditions right at home.

Likewise, there are about 15 similar transmitters broadcasting across southern Canada.

If you're traveling, it pays to occasionally tune in weather forecasts on the 162-MHz frequencies so you'll know what's going on several miles down the road before you actually drive into it. Also, don't be surprised to find weather receivers at rest stops on interstate highways. In fact, in some states, low-power traveler information service transmitters on the AM broadcast band retransmit weather stations from VHF. As a result, travelers need only to tune in the posted AM broadcast frequency on their car radios.

VHF Marine

While all VHF marine radios are equipped to receive NOAA weather broadcasts—the 162-MHz weather frequencies are very close to the marine telephone channels at the upper end of 161 MHz—there are other channels to tune for weather information on marine radio.

In many areas of the U.S. where there is boating on lakes, rivers, and oceans, the U.S. Coast Guard usually makes announcements on marine Channel 16 (156.800 MHz), the distress and calling frequency, before transmitting weather

information. During the announcement, the Coast Guard will usually instruct mariners to tune their radios to channel 22A ("22 Alpha"), or 157.100 MHz, for further information. The Coast Guard broadcasts information necessary to mariners, including weather, several times a day on this channel. If bad weather is approaching, mariners will be advised on this frequency, which is used by the Coast Guard as a liaison frequency with the boating public.

In Canada, weather broadcasts in some areas can be heard on 161.650 MHz.

As boaters respond to bad weather, you might hear activity on the various VHF marine frequencies in the 156-MHz band as they rush back to port or shore.

If you have a shortwave receiver, you may hear Coast Guard weather broadcasts on high-seas frequencies such as 2670, 3023, 4428.7, 5320, 5680, 5692, 6506.4, 8765.4, 8980, 8984, 11195, 11198, 15081, 15084, and 13113.2 kHz.

Storm Riders

The NOAA uses a shortwave radio system to communicate with its reconnaissance aircraft during hurricanes. The aircraft track major hurricanes and even fly into the eyes of storms to collect data.

"Hurricane Hunters" usually use one of the following frequencies: 3407, 5562, 6673, 8876, 10015, 13354, 17901, or 21937 kHz.

Weather Responders

If a major storm has hit an area of the U.S. and caused a lot of damage and possibly loss of life, the Federal Emergency Management Agency (FEMA) may come on the scene with a cache of radio equipment to assist local officials.

FEMA primarily uses the 138, 139, and 142-MHz bands. Typical FEMA frequencies follow: 138.575R, (Midwest), 142.350R (Northeast), 139.450R, 139.825R, 139.950R, 140.025R, 142.375, 142.425, 142.975R, and 143.000 MHz.

While FEMA has the capability of transmitting on any HF frequency, the following are typically used: 3113, 4780, 5211, 7348, 10493, 11957, 12216, and 17649 kHz.

On the Air, In the Air

Next to NOAA weather broadcasts on 162 MHz, VHF aviation frequencies are probably the next best source of weather information. From automated transmissions to customized weather data for planes in flight, there's plenty of weather information to be found.

Planes that are higher than 20,000 feet are considered high altitude. Generally, there's a frequency reserved on the aeroband in each area of the country for high-altitude planes to receive enroute advisory information, including weather. Here is a listing of these frequencies for each air route traffic control center:

CENTER	FREQ
Albuquerque Center, NM	127.625, 134.825
Atlanta Center, GA	135.475
Boston Center, MA	133.925
Cleveland Center, OH	135.425
Denver Center, CO	124.675
Fort Worth Center, TX	133.775
Houston Center, TX	126.625
Indianapolis Center, IN	134.825
Jacksonville Center, FL	135.175
Kansas City Center, MO	128.475

Parts of the Air Florida Boeing 737 that crashed into the Potomac River are salvaged. Listening to aircraft communications on both HF and VHF is one way to keep up with fast-changing weather conditions. (Photo courtesy of REACT.)

Weather Spotting

If you're interested in becoming a trained weather spotter, contact your local National Weather Service office. They can advise you when a class will be held in your area so you, too, can learn to become a weather spotter.

Weather spotters are given the following guidelines to help them file reports:

1. From radio-equipped vehicles, severe weather observations should be reported to a central collection point and then forwarded to the National Weather Service. (Law enforcement and emergency management spotters generally forward their reports directly to the weather service).

2. When the telephone is the only communications method, the primary notification point should be asked to relay your report to the National Weather Service. However, if the spotter is unable to reach the primary contact point, the information may be forwarded directly to the weather service.

How to Report

Spotters are asked to report the following:

- WHAT was seen, such as wall cloud, tornado, funnel cloud, waterspout, heavy rain, etc.
- WHERE it was seen, meaning direction and distance from a known location.
- WHAT it was doing, which should include a description of the storm's direction and speed of travel, size and intensity, and destructiveness.
- WHO you are, using the code number most trained spotters are assigned to readily identify them.

What to Report

The National Weather Service requests reports that offer information on the following:

- Tornado, funnel cloud, waterspout or wall cloud.
- Hail, quarter-inch or more.
- Damaging winds, usually 50 mph or greater.
- Flash flooding.
- Rain at the rate of an inch per hour or greater.

Los Angeles Center, CA	135.900
Miami Center, FL	132.725
Memphis Center, TN	133.675
Minneapolis Center, MN	135.675
New York Center, NY	134.725
Oakland Center, CA	135.700
Salt Lake City Center, UT	133.025
Seattle Center, WA	135.925
Washington Center, D.C.	134.525

Military Watch

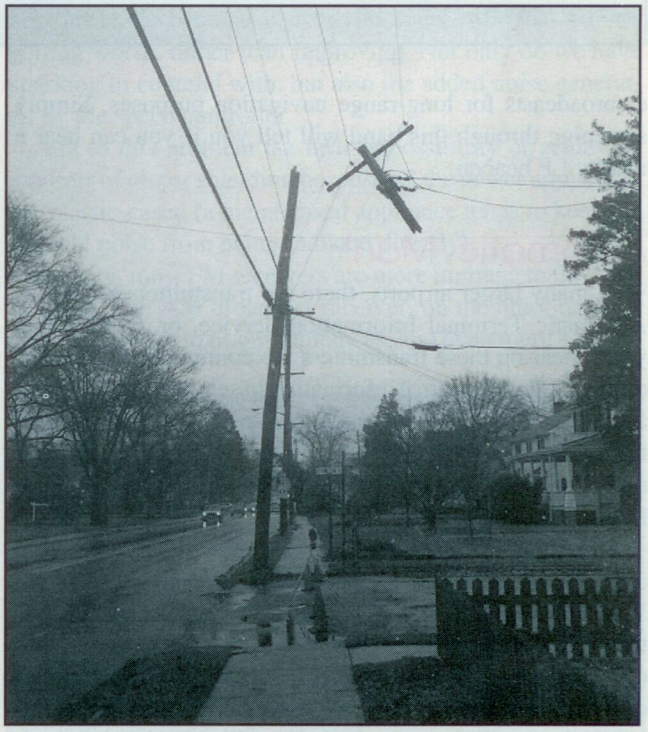
Various military airfields across the country are equipped to provide weather information to military pilots. At the same time, those same military pilots are obligated to keep weather facilities posted on weather conditions encountered during their flights.

A total of six frequencies in the military aviation band are used for this purpose. These frequencies, known as "pilot to metro service," may or may not have local weather radar capability. To monitor these transmissions, you must be able to receive the 225-400 MHz military aeroband in the AM mode.

The following are the "metro" frequencies for military aviation weather (all AM mode): 239.800, 342.500, 344.600, 375.200, 308.800, and 297.400 MHz. In addition, 120.300 MHz in the VHF aeroband is used for metro purposes.

Lowfers

If your shortwave receiver can tune in the 100-500 kHz low frequency (LF), or "lowfer" band, you may also be able to hear non-directional beacon transmitters that offer weath-



Tune local utilities with your battery-operated scanner to keep up-to-date during severe weather. (Photo by Jennifer Ort.)

NOAA Weather Radio: A Lifesaver for the Cost of a Pair of Shoes

...A family is awakened in the middle of the night by an alarm on their weather radio. The special receiver carries a tornado warning advising them to seek cover. They retreat from their mobile home to a nearby shelter, just moments before a twister tears through the community, scattering lives and mangled aluminum in its wake.

...A recreational vehicle owner in a campground picks up a flash flood alert on his weather radio and moves to higher ground. Minutes later, a wall of water sweeps through his former campsite.

These are typical scenarios. In both cases, lives are saved by a small radio receiver costing less than a new pair of shoes.

Weather reports and warnings such as these are broadcast around the clock by the NOAA directly to home receivers. Some weather radios even have the capability to receive a tone alert signal, triggering a built-in alarm that warns listeners of severe weather announcements.

But despite hundreds of real-life stories like those mentioned above, NOAA Weather Radio remains one of the best kept secrets in the U.S. And it's a costly secret, according to Stanley Johnson, NOAA Weather Radio program manager.

"In many instances, NOAA Weather Radio advises people of severe weather alerts and warnings ahead of the mass media, buying extra time for people to react before dangerous storms hit their areas," says Johnson. "When you're in the path of something like a funnel cloud, minutes and seconds can mean the difference between life and death."

Weather service offices tailor their NOAA Weather Radio broadcasts to suit local needs and commercial interests. Oklahoma broadcasts, for instance, may offer more agricultural information and alert people about high winds or tornadoes. Broadcasts in New England may focus on marine weather conditions for recreational boaters and fishing and shipping vessels.

Routine information is updated every one to three hours, and the broadcasts repeat every five minutes or so. Weather stations immediately interrupt regular reports when a severe weather situation requires a live alert or warning. These reports will air on one of seven VHF high-band FM frequencies between 162.400 and 162.550 MHz.

NOAA Weather Radio broadcasts began in the 1950s when the old Weather Bureau started broadcasting aviation weather over two stations. Since then, other stations have been added for the marine community, and now more than 380 transmitters are within the listening range of most of the nation's population.

Today, the National Weather Service is modernizing. It's building a network of improved radars, satellites, data buoys, supercomputers, and telecommunications capabilities aimed at saving lives and preserving property.

But state-of-the-art technology and accurate warnings and forecasts are of little value if people who need the information don't receive it in a timely manner. That's why the Weather Service also is modernizing NOAA Weather Radio. Efforts are underway to replace its 1960s-era audio consoles with programmable, computer-based systems. The new technology will automatically convert weather messages directly from electronic text to speech and broadcast it at appropriate times. And additional transmitters will expand the system's coverage to isolated areas.

Advocates of NOAA Weather Radio foresee a future for specially-tailored "narrowcasts." Such messages, for example, would automatically warn mariners about extremely high tides by sending a special message to receivers equipped to recognize a special broadcast signal.

New partnerships are developing between the National Weather Service, other federal agencies, private industry, and state and local governments to expand NOAA Weather Radio into an "all-hazards" network. "All-hazards broadcasts would air warning information on earthquakes, volcano activity, and man-made hazardous conditions. It would also be used for communicating relief information after such disasters," said Edward Gross of the National Weather Service.

"Our goal is to someday have a NOAA Weather Radio in every home, just like a smoke detector, and in all schools, hospitals and other public gathering places," said Gross, who heads the Weather Service's Office of Industrial Meteorology. "It'll give people the kind of information they need to safeguard themselves and their homes during a disaster."

er broadcasts for long-range navigation purposes. Simply sweeping through this band will tell you if you can hear a nearby LF beacon.

Automatic, Man!

At many larger airports, there are transmitters known as Automatic Terminal Information Service, or ATIS. What you'll hear on these transmitters are continuous broadcasts of recorded non-control information in selected areas of high activity. If weather is a problem somewhere within range of the facility, you may hear about it on one of these ATIS channels. These ATIS transmissions show up just about anywhere in the VHF aeroband.

A recent innovation for smaller airports is a service known as Automated Weather Observation System, or AWOS. Basically, AWOS employs a computer-generated voice to transmit local weather conditions over a VHF aero frequency for pilots about to take off. By tuning in these frequencies at the smaller airports, pilots typically can hear time in UTC (the world time standard generally used by aviation), current and forecasted sky conditions, visibility, temperature, dew point, wind speed, direction, and altimeter. The data is usually transmitted every minute and updated every minute as well.

For people who live anywhere near one of these smaller airports, listening to the local AWOS frequency will offer the best weather updating information short of putting up your own weather station!

Other Sources

There are other places to turn to for weather information on a local basis. You may find these frequencies only through regular monitoring.

For instance, the frequency used for a toll road—either police or maintenance—may offer weather condition updates several times a day. The Pennsylvania Turnpike, on 159.045 and 159.075 MHz, gives updates several times a day on these two frequencies, detailing roadway and weather conditions for the entire stretch of the toll road.

Likewise, some public safety agencies also offer weather information. The Iowa State Patrol broadcasts roadway information several times a day during inclement weather on

Raging flood waters take their toll on anything in their path. (Photo courtesy of REACT.)

Scenes like this are common when ferocious weather takes aim at coastal areas. (Photo courtesy of REACT.)

its statewide network of transmitters on 155.790R, 155.685R and 155.700R MHz. In addition, many states' Department of Transportation highway frequencies also carry similar information during inclement weather.

Other sources of weather information that might assist motorists are reports from traffic reporting services in metro areas. These reports, usually provided over 450- and 455-MHz news media channels to radio and TV stations, are primarily known for traffic information. But weather information is tied in when adverse conditions make the going tough.

In addition, if there is a radio team in your vicinity that uses the general mobile radio service in the 462-MHz band, you may want to monitor their repeater for weather reports from members. REACT and many other public service teams usually use 462.675 MHz on a national basis.

Amateur Networks

One of the largest networks of weather observers in the U.S. is made up of amateur radio operators who use their ham equipment to keep abreast of adverse weather.

In most areas, National Weather Service meteorologists offer training to licensed hams in observing and reporting problem weather conditions. In the Midwest, most hams are trained in tornado spotting and usually have special methods of notifying weather officials when a tornado is detected.

The amateur system falls under the Skywarn network. Under this network, severe storm information is reported either directly to the National Weather Service office or to the primary contact point for a given county, usually a 911-dispatching center. In fact, in some National Weather Service offices, such as Moline, Illinois, ham stations are set up to directly receive weather reports from other hams. A ham usually responds to the weather service office and funnels reports from other ham observers to meteorologists for analysis.

Some amateur repeaters are automatically used for storm spotting or Skywarn activities whenever the weather looks threatening. A net control operator typically gathers reports and relays them to proper authorities. For instance, the meteorology department at Western Illinois University in Macomb, Illinois, transmits its weather radar picture on UHF amateur television frequencies. This provides hams with the same visual radar imagery the meteorologists receive.

HF and Birds

There are so many sources of weather information via radio that it's impractical to list all of them here. On the HF bands, weather broadcasts from New York Center and Gander, Newfoundland, can also be found loud and clear on a number of shortwave frequencies almost any time, day or night. On the 137-MHz band, many weather satellites keep an eye on weather and transmit data back to earth. Hobbyists armed with the proper equipment can receive these satellite pictures on their computers.

So if you thought your local news station and the 162-MHz NOAA weather transmitters were the only source of weather information, you just haven't looked far enough. Why not spin the dial and keep an ear out. That big storm may be coming your way! ■

NOAA up Close

The NOAA conducts research and gathers data about the oceans, the atmosphere, the sun, and space, and it applies this knowledge to science and services that touch the lives of all Americans. The NOAA warns us of dangerous weather, charts our seas and skies, and guides our use of our natural resources. Its research has improved our understanding and stewardship of the environment which sustains us all.

A Commerce Department agency, NOAA provides these services through five major organizations: the National Weather Service, the National Ocean Service, the National Marine Fisheries Service, the National Environmental Satellite, Data, and Information Service, and the Office of Oceanic and Atmospheric Research, as well as numerous special program units. In addition, NOAA research and operational activities are supported by the nation's seventh uniformed service, the NOAA Corps. This corps of 400 commissioned men and women operates NOAA ships and aircraft and serves in scientific and administrative posts.

For further information, you can write to NOAA, Office of Public Affairs, Room 6013, Herbert Clark Hoover Building, Washington, D.C. 20230. Phone: (202) 482-6090.

Radio And The Law

What's legal and what's not? Here's the latest....

By Michael A. Covington, N4TMI

Newcomers to the radio hobby are often puzzled about laws and regulations affecting what they do. Some are surprised that it's legal to listen to police and fire calls (which it is); others are surprised that they aren't allowed to set up their own high-powered transmitters without a license. And still others wonder if they can sue their neighbors over interference to their TV reception. In this article I'll briefly sketch out the laws and regulations that affect radio technology in the U.S., and I'll try to explain why the restrictions are necessary.

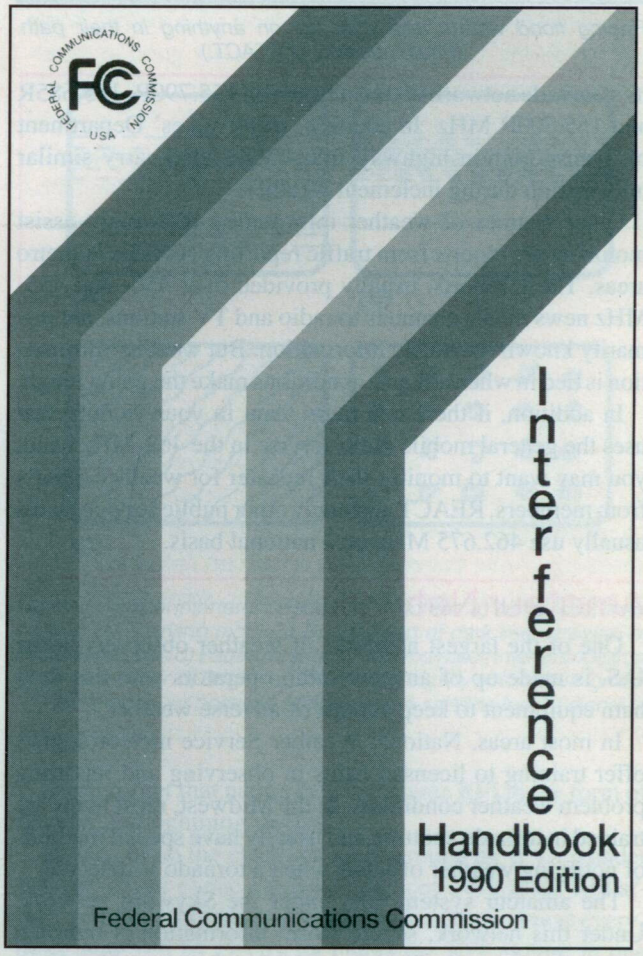
What you can listen to

First the good news: You don't need any kind of license to listen to radio communications. In fact, you're welcome to listen not only to broadcasts, but also to police and fire calls, aircraft, ships, hams, CBers, and many other kinds of signals.

Until 1986, the only restriction was that if you listened to transmissions you couldn't make use of the information you received, nor could you pass it along to other people, unless it was broadcast or transmitted by amateurs or others for the use of the general public. This rule goes back to the Communications Act of 1934 (47 USC 605).

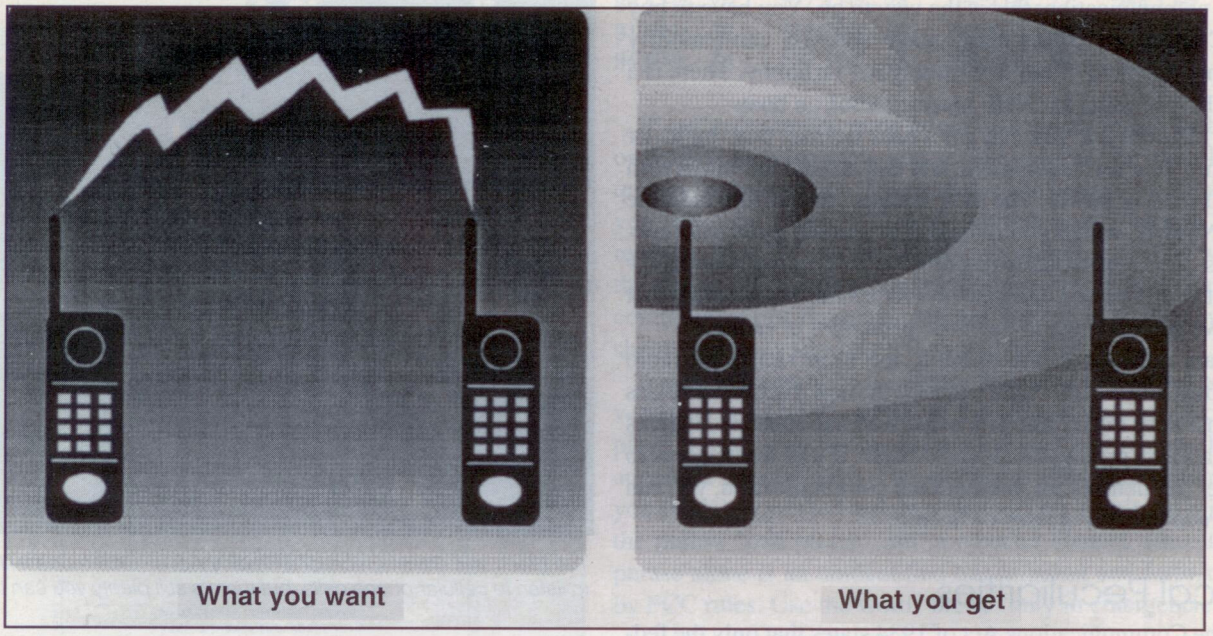
In 1986, Congress passed the controversial Electronic Communications Privacy Act (ECPA, 18 USC 2510-2511), designed to bring anti-wiretapping laws into the radio age. Under the ECPA, you can still listen to ships, aircraft, police, fire departments, civil defense, business mobile radios, hams, CBers, and the like. But you can't listen to communications that are intended to be private. Specifically, you can't listen to cellular or cordless phone calls, ship-to-shore phone calls, microwave or satellite transmissions not intended for the public, digital data transmissions, or any transmission that is scrambled, encrypted, or transmitted on a subcarrier.

Clearly, the ECPA is an attempt to balance the privacy of cellular phone users (who are, after all, using radio communication) against the freedom of scanner hobbyists and other listeners. Many experts think the ECPA made the wrong move: it should have required cellular phone systems to scramble their signals, rather than making it illegal to listen to them in their present (unscrambled) form. Anyone who really wants to eavesdrop—and I'm talking about spies and criminals here, not hobbyists—won't be deterred by one more law, as long as the eavesdropping is still technologically easy to do.



The FCC's Interference Handbook *contains a wealth of good information about tracking down and eliminating interference. It's available through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.*

Originally, cordless (not cellular) phones were not considered private under the ECPA. The reason is that they are assigned haphazardly to a small number of frequencies, with nothing to keep them from picking up each other's signals. But another federal regulation (47 CFR 15.9) prohibits tele-



Why transmitters have to be restricted: Signals always cover a whole area, not just the intended receiver.

phone eavesdropping, and in 1994 Congress amended the ECPA to close the loophole, so that cordless and cellular phones are now treated alike. The ECPA still doesn't have anything to say about wireless intercoms, baby monitors, and the like, but 47 CFR 15.9 apparently prohibits listening to their signals as well.

Another sticking point is the sub-carrier audio (SCA) signals on FM broadcast stations. According the ECPA, these are now illegal to listen to without the permission of the sender. Many SCA signals carry foreign-language or special-interest broadcasts, audio books for the blind, and the like, and the sender would welcome additional listeners. Some SCA signals, however, provide commercial information services of various kinds and are meant to be used only by paying subscribers.

Transmitting restrictions

Transmitters are a different story. The drawing above shows why transmitters have to be restricted—the signals don't just go to one receiver, they blanket a whole area on a particular frequency. What's more, there's only a finite range of frequencies available, and every signal occupies not just one frequency, but a narrow range called its bandwidth (if your town has an AM station on 950 kHz, it can't have another one on 951, or 952, or even 955).

Thus, the radio spectrum is a scarce public resource and its use has to be regulated to keep all of it from going to the richest and greediest users. Radio stations submit willingly to regulation and licensing because they all benefit from it. If you've just spent a million dollars building a radio station on 950 kHz, you don't want your competitor popping up on 951. You want assurance that people are actually going to be able to hear you. Similarly, if you've invested in a business two-way radio system, you don't want someone blundering onto the same frequency on their own. That's the reason for licensing.

A further problem is that there's no limit to how far a signal can travel. If you have reliable communication over a particular distance, then you almost certainly have some noticeable signal traveling 10 or 100 times as far. So if you transmit on your own, you have no way of knowing how much interference you're causing. Possible victims include not only broadcast listeners, but also two-way radio systems, navigational devices, and even medical instruments.

So what do you do if you want to transmit? Any of several things:

(1) You can use very-low-power transmitters that don't require a license, such as wireless intercoms and 49-MHz walkie-talkies. Under some conditions you can even build your own low-power transmitter, but the regulations are complicated; it's best to work from published plans or kits. Don't modify the equipment to raise the power.

(2) You can use CB equipment. It's easier to start this way, rather than building your own equipment. You're allowed up to 4 watts of output power. You can experiment with antenna design to your heart's content, but you can't build or modify your transmitter.

You can't legally use a linear amplifier to blanket the whole U.S. with your signal. There are only 40 channels, and you can't have 1/40 of the whole nation's CB spectrum all to yourself. The FCC is quite strict about this and has imposed multi-thousand-dollar fines. An added problem is that "linears" are usually of low quality and cause lots of interference.

(3) For business communication, you can get a business VHF or UHF radio license from the FCC. If you want reli-

able communication, this is the way to go. You have to buy FCC-approved radios ready-made and you can't modify them—this kind of radio definitely isn't a hobby. There is a similar provision for VHF marine radios on boats.

(4) Best of all, you can get a ham license, buy, build, or modify your own equipment, and talk around the world with 1500 watts of power. The FCC assigns you call letters (mine are N4TMI) which you must use to identify your transmissions. You're personally responsible for keeping your equipment on frequency, and you have to pass an examination that shows you understand the basic principles of radio.

Ham radio is, in my opinion, the most satisfying radio hobby. Unlike earlier ham licenses, the new Technician Class license does not require you to learn Morse code, and it gives you all ham privileges above 30 MHz. If you want access to lower frequencies for international communication, you can upgrade to other classes of license.

The Electronic Communications Privacy Act of 1986 made it illegal to listen to cellular phone calls, but there's still plenty you can tune.

Local Peculiarities

The Communications Act of 1934 states that only the federal government can regulate radio because radio signals are interstate commerce as defined by the U.S. Constitution.

That's important, because local governments and neighborhood associations often regulate things that affect radio communication. Some of the regulations are reasonable—no 1,000-foot towers in crowded residential areas—but some are quite ill-conceived. For example, some of the real estate covenants in my home town ban "all radio-frequency generating apparatus." Do these folks know they've banned their own microwave ovens and cellular phones? Of course not, and the covenant presumably wouldn't stand up in court, but I'm glad I'm not the one who has to challenge it.

In its famous PRB-1 ruling (1985), the FCC ruled that local governments must make reasonable accommodation for ham radio antennas. They don't have to permit everything (such as the aforementioned 1,000-foot tower), but they can't ban antennas entirely because ham radio is part of our nation's emergency preparedness system. Unfortunately, PRB-1 only preempts local laws, not deed covenants, which are supposedly voluntary agreements.

Interference

What do you do when your neighbor's transmitter or other equipment seems to be interfering with your reception? Technically, there are three possibilities:

(1) Maybe the transmitter is emitting something it shouldn't. For example, a 27.5-MHz CB linear amplifier can emit harmonics on 82.5 MHz, zapping TV channel 6.

(2) Maybe the receiver is picking up something it shouldn't. This is a much more common problem than peo-

The PRO-2006 is still a favorite among serious scanner enthusiasts. Its wide coverage enables tuning the VHF/UHF spectrum with ease!

ple realize. You know that your TV picks up TV frequencies; but who guarantees that it doesn't pick up some other frequencies too?

(3) Maybe the signal you want to listen to is just too weak. If you try to listen to an FM station 200 miles away, you'll get a weak signal with lots of interference. That doesn't mean the interference is anyone's fault. It's just that the incoming signal isn't strong enough to overcome other types of noise.

The FCC regulates interference. Deliberate interference—that is, transmitting a signal for the purpose of interfering with someone's reception—is always illegal. Apart from that, the FCC sets standards for the performance of transmitters and other devices that emit RF energy. Interference can't be reduced to zero, but it can be kept down to a reasonable level. It's a matter of balancing some people's desires against others'; you can't ban automobile engines and electric razors all over your town just because you want to hear Radio Timbuktu.

What do you do if your neighbor is complaining about your ham or CB transmitter? First, be helpful and polite, no matter how off-base the complaints may be. Some people are confused about radio hobbyists and think we're all pirate broadcasters with kilowatt amplifiers made of scotch tape and baling wire. There are numerous funny stories about how people have complained about interference from a new, prominent antenna that turned out not to have a transmitter connected to it.

Second, encourage your neighbor to contact the FCC. If your own operations are legal, you have nothing to lose. Your neighbor will get a helpful booklet about how to resolve interference problems, making the important point that interference is not always the fault of the transmitter. If ham radio is involved, you or your neighbor should also contact the American Radio Relay League, Newington, CT 06111.

Third, don't install any filters or other modifications on your neighbor's equipment yourself, even if it's a simple job. Remember that you're dealing with someone who doesn't trust you (even if they momentarily seem to) and who may blame you for any future difficulties with the equipment. Offer to pay to have a repairman do the job, if necessary.

I hope this overview of some of the important laws and regulations governing radio has answered some of your questions. It's possible that it may have raised some others you hadn't thought of before. There are many fine publications available to assist you. Another good source for finding out more about regulations affecting your particular hobby is a local club. Learn from those who've been there before you and start enjoying radio right away. ■

NEW! The home/mobile scanner preprogrammed with

2,193 frequencies to go!

This may be the most convenient scanner you'll ever use! Radio Shack's new PRO-2038 zeroes in on local action right out of the box thanks to 2,193 preprogrammed radio frequencies for police, fire, emergency, aircraft, marine and weather services. And because you can power it from home AC plus vehicle 12VDC with an optional power cord, you can scan for active frequencies wherever you are. Great for travel!

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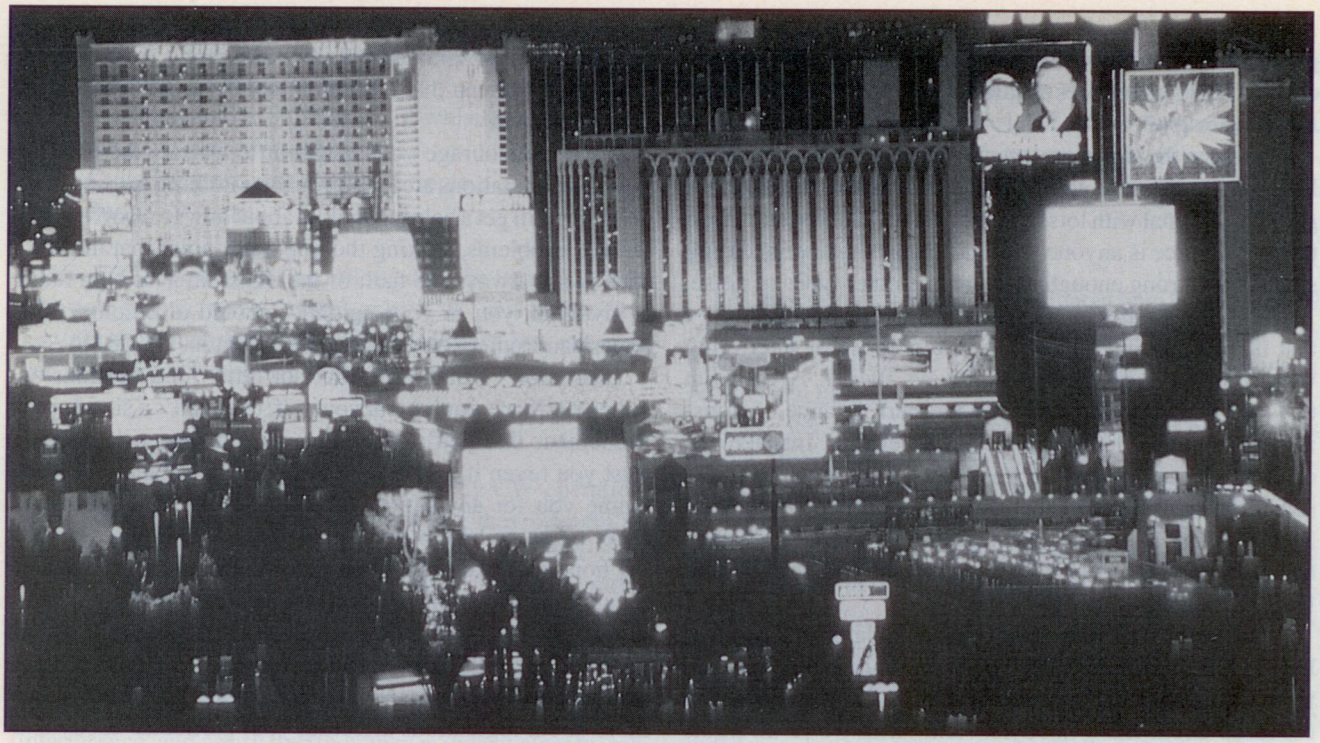


No doubt you'll find the hottest scanning action on the Las Vegas Strip, home of many casinos and hotels. Scan the 461–465 and 851–866 MHz bands for most of the action. You'll hear jackpots and more! (Photo courtesy Las Vegas News Bureau.)

Going To Nevada Or Las Vegas? Bet You Can Hear These Comms!

You don't need much luck to hear the action, just your handheld scanner and Chuck's list.

By Chuck Gysi, N2DUP

Nevada, the Silver State, is probably better known as the gambling state. Or perhaps, the wedding state. It's also known for other things it perhaps would rather not be known for. One thing is certain, however: A lot of people are making Las Vegas their home, and many more visit the state on an increasing basis each year. Because of this, there's plenty to monitor if you're visiting or moving to Nevada.

So, whether you're just passing through or settling in, here are the primary frequencies to monitor.

Statewide

Nevada Highway Patrol

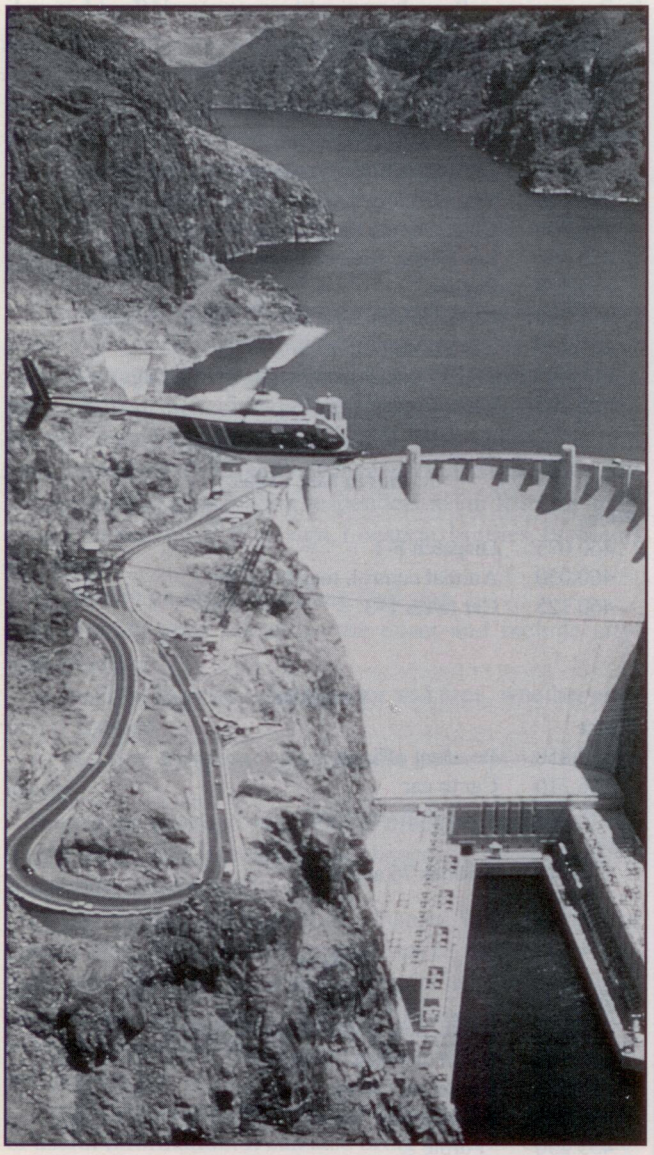
42.940	Base to car / rural dispatch F-1
42.780	Car to base / rural dispatch F-1
42.500	Car to car F-2
42.700	Car to car F-3
42.880	Las Vegas, Reno areas dispatch F-4
42.740	Car to car F-5
42.580	Carson City statewide dispatch, various agencies F-6
42.560	Car to car, California Highway Patrol mutual aid F-7
42.800	Car to car, aircraft radar operations F-8
154.920	Mobile extenders
155.475	Nationwide mutual aid F-1 handhelds
155.655	Nevada mutual aid F-2 handhelds
156.075	Nevada incident command F-3 handhelds

Miscellaneous law enforcement

453.300	Nevada Gaming Board surveillance
155.415	Prisons

Lake Mead offers scanning action for those visiting Nevada. Check out the VHF marine channels for boaters' communications. (Photo courtesy Las Vegas News Bureau.)

Lake Tahoe is a very popular place for visitors coming to Nevada. Check our frequency lists for the right frequencies to monitor. (Photo courtesy Nevada Commission on Tourism.)



Hoover Dam is one of Nevada's most popular attractions outside Las Vegas. (Photo courtesy Nevada Commission on Tourism.)

155.580	Prisons
155.475	Motor Vehicles
453.775	Taxicab Authority

Mutual aid systems

154.280	Fire mutual aid F-1
154.265	Fire mutual aid F-2
154.295	Fire mutual aid F-3
155.145	Rural emergency medical service F-4
155.715	Emergency medical service F-5
155.475	Nationwide police mutual aid F-6
155.655	Nevada law enforcement mutual aid F-7
155.160	Search and rescue mutual aid F-8
156.075	Incident command F-9

Department of Transportation

151.010	West-central and northeast
151.040	South (Las Vegas) and northwest
151.100	East-central
151.130	Southwest
159.180	Car to car
451.025	Carlin Canyon Tunnel base
456.025	Carlin Canyon Tunnel mobiles

Conservation

151.475	Department of Wildlife primary
151.460	Department of Wildlife car to car
158.895	Division of Forestry primary
159.345	Division of Forestry car to car "Red"
159.270	Division of Forestry car to car
151.175	Conservation aircraft
151.340	State parks

National forests, recreation areas

169.900	Humboldt National Forest
171.475	Humboldt National Forest
168.750	Modoc National Forest
170.175	Modoc National Forest
169.125	Modoc National Forest
169.950	Modoc National Forest
171.500	Tahoe National Forest
168.175	Tahoe National Forest
168.775	Tahoe National Forest
169.875	Toiyabe National Forest
164.475	Boulder Dam police
166.300	

There's plenty of skiing in Nevada. Check for National Ski Patrol members in the 155 MHz band. (Photo courtesy of Incline Village and Crystal Bay Visitor's and Convention Bureau.)

Golf is another attraction for those spending time in the Silver State. Golf and country clubs usually operate on VHF and UHF business frequencies. (Photo courtesy of Elko Chamber of Commerce.)

163.050	Boulder Dam construction
166.300	Lake Mead National Recreation Area primary
168.350	Lake Mead National Recreation Area special events
417.375	Marine Channel 16 link

Carson City

Sheriff

155.970	Dispatch F-1
155.250	F-2
155.535	F-3
155.685	F-4

Fire

154.430	Dispatch F-1
154.145	F-3
154.175	F-4
155.175	Rescue dispatch
155.160	Rescue car to car

Las Vegas

Metro police

159.150	Information, detectives F-1
159.090	Southeast patrol F-2
158.970	Car to car F-3
158.745	Northeast patrol F-4
159.210	Car to car, vice F-5
159.030	Northwest patrol F-6
158.790	Administration, detectives F-7
156.210	Car to car F-8
158.850	Rural (Blue Diamond, Sandy Valley) F-9
158.850	Rural (Glendale, Logandale, Overton, Moapa) F-10
158.850	Rural (Laughlin, Searchlight) F-11
156.210	Car to car, surveillance F-12
156.030	Search and rescue (Mount Potosi) F-13
156.030	Search and rescue (Gass Peak) F-14
156.030	Search and rescue car to car F-15
460.400	Auxiliary police
460.200	Mobile data terminals
460.525	Mobile data terminals
155.370	Car to car, surveillance
155.475	Nationwide mutual aid
155.520	Car to car
155.820	Paging

Fire

453.150	Las Vegas dispatch (downtown, east) F-1
453.100	Clark County dispatch (west, South Strip) F-2
453.700	Clark County dispatch (east) F-3
453.400	Las Vegas dispatch (west, North Las Vegas) F-4
154.370	Paging
154.340	Clark County rural fire (Laughlin), paging
154.430	Fire prevention, paging
154.400	Clark County rural fire (Indian Springs)
154.205	Clark County fire

North Las Vegas

Police

460.075	Dispatch F-1
460.050	Animal control, marshal F-2
460.125	Car to car F-3

Laughlin

Police

158.850	Resident officers F-11
156.210	Car to car
158.955	Township constable

Fire

154.340	Stations 76 and 85

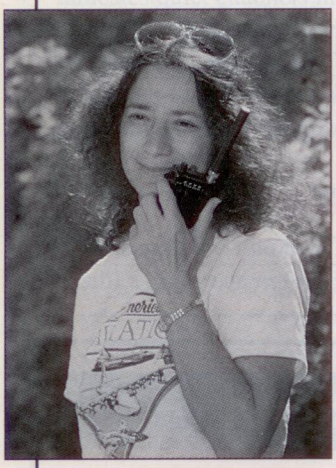
Reno

Police

453.650	North, downtown dispatch "Green"
453.700	South dispatch "Yellow"
453.575	Car to car "White"
453.600	Information "Blue"
453.250	"Purple"
460.075	"Black"
155.520	Washoe County sheriff dispatch "Green"

One Size Fits All!

Amateur Radio



If you want to get in on the fun and excitement of personal radio communications—from talking to friends across town, to making new friends in dozens of foreign countries—Amateur Radio is for you!

More than two million people around the world share a fascination with the diversity and friendships Amateur Radio brings to their lives. Amateur Radio is a multifaceted method of communication that fits every lifestyle.

Who are these Amateur Radio enthusiasts? Kings, country western singing stars, senior citizens, astronauts, school children, mechanics and homemakers, to name just a few. Anyone can enjoy Amateur Radio, regardless of age, gender, occupation or physical ability.

The best part about Amateur Radio is that there are so many activities to explore—finding your perfect fit is half of the fun. You can operate a two-way radio station from your easy-chair, computer, car, boar, camper or even from a mountaintop! It's two-way mobility with a capital "M."

Amateur Radio is fun and convenient—and it's great for emergencies. You can talk to other hams (Amateur Radio operators) across town, across the globe and even beyond. Ever imagine talking to an astronaut in orbit or bouncing a signal off the moon and back? Amateur Radio operators do it every day—and you can, too.

Finding out how you can get started in ham radio couldn't be easier. We're the American Radio Relay League, the largest Amateur Radio membership organization in the country, and we've been helping hams (and future hams) get started for more than 75 years. We'll help you, too.

A great way to get more acquainted with Amateur Radio, or enhance your ham radio enjoyment if you're already licensed, is membership in the ARRL. In addition to invaluable services, benefits and access to dozens of specialized ham radio books, each month you'll receive your membership journal, *QST*. Weighing in at more than 200 pages per issue, *QST* is packed with Amateur Radio news, features, operating tips, technical advice *and* a very special section for beginners: *New Ham Companion*. You'll get the whole picture—everything that's going on in the amateur community, and you'll be able to take advantage of everything Amateur Radio has to offer.

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The easiest way to get the "ball rolling" is to ask for our free "Getting Started in Amateur Radio" package. Included is all the information you need to find out about how you can get on the air with your own ham radio station.

If you're already a ham—or think that you want to be!—call the toll-free number and sign up for a 1-year ARRL Membership. Membership in the American Radio Relay League—the national organization of Amateur Radio operators—is an invaluable help in getting a good start in ham radio. As an ARRL Member, you'll expand your Amateur Radio horizons with expert information on virtually every Amateur Radio topic and enjoy membership services tailored to your needs as a new ham.

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(1-800-32-63942)

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203-666-1541 (voice) ■ 203-665-7531 (fax)

155.010	Washoe County sheriff supervisors "Blue"
155.985	Washoe County sheriff car to car "White"
154.860	Washoe County sheriff jail officers "Brown"
155.130	Washoe County sheriff (Incline Village)
154.950	Washoe County sheriff detectives
154.725	Washoe County sheriff north patrol

Fire

453.750	Dispatch
453.050	Fireground
460.550	Data
155.205	Washoe County sheriff search and rescue "Red"

Sparks

Police

155.130	Dispatch F-1
155.850	Car to car F-2
154.115	Car to car F-3

Fire

158.775	Dispatch

Future trunked 856.2125, 857.2125, 858.2125, 859.2125, 860.2125

Las Vegas Casinos, Hotels, and Related Frequencies

Freq.	Licensee
151.655	Flamingo Hilton Hotel and Tower
151.685	Flamingo Hilton Hotel and Tower
151.745	El Cortez Hotel
151.775	Hotel Frontier
151.775	Horseshoe Club Operating Co
151.895	Circus Manor
151.925	Circus Circus Inc
152.480	Marina Hotel Inc (Paging)
152.480	Dunes Hotel & Country Club (Paging)
153.845	Las Vegas Convention and Vistors Authority
153.860	Las Vegas Convention and Vistors Authority
153.935	Las Vegas Convention and Vistors Authority
154.515	Ballys Ziegfield Theatre
154.540	Hotel Linen Services Inc
154.540	Vagabond Inn Las Vegas
154.625	Marina Hotel (Paging)
155.985	Las Vegas Convention and Vistors Authority
157.620	Golden Nugget Las Vegas Inc
157.740	Aladdin Hotel & Casino (Paging)
158.460	Caesars World (Paging)
158.835	Las Vegas Convention and Vistors Authority
451.225	Hilton Hotels Corporation
451.425	Caesars Palace Realty Corp
451.475	Hilton Hotels Corporation
451.575	Circus Circus
451.600	Ballys Las Vegas
451.625	Harrahs Las Vegas
451.700	Caesars Palace Realty Corp
452.275	Las Vegas Hilton Hotel
452.475	Ballys Casino Resort Las Vegas
452.675	Showboat Hotel & Casino Shuttle & Security
452.775	Eastern Western Hotel Corp

There's nothing that attracts visitors to Las Vegas more than gambling. The casinos offer lots of scanning action, but leave your scanner in your hotel room unless you want to run into trouble with security guards. (Photo courtesy Las Vegas News Bureau.)

452.800	Las Vegas Strip Trolley
460.9125	Sands Hotel and Casino
460.9375	Sands Hotel and Casino
461.050	Horseshoe Club
461.075	Harrahs Las Vegas Inc
461.125	Vegas World Hotel & Casino
461.200	Imperial Palace Inc
461.275	La Concha Motel
461.325	Flamingo Capri Hotel
461.350	Games of Nevada
461.375	Western Hotel and Casino
461.425	Showboat Bowling
461.525	Sams Town Slots
461.550	Golden Nugget Las Vegas Inc
461.600	El Rancho Casino
461.675	Tropicana Casino
461.750	Hotel Golden Nugget
461.775	Caesars Palace
461.925	Las Vegas Hilton Catering
461.950	Caesars World Inc Corporate Security
462.000	Golden Nugget Las Vegas Inc
462.050	Sands Hotel and Casino
462.150	Four Queens Hotel Casino
462.175	El Cortez
462.275	Casino Operations Inc
462.325	Las Vegas Hilton Inc
462.450	Harrahs Las Vegas Inc
462.475	Imperial Palace Inc
462.725	Airport Inn
462.750	Gold Coast Hotel and Casino (Paging)
462.750	Las Vegas Hilton (Paging)
462.775	Vegas World (Paging)
462.775	Stardust Hotel and Casino (Paging)
462.825	Ballys Casino Resort (Paging)
462.850	Hilton Hotel Corp (Paging)
462.850	Fitzgeralds Casino Hotel (Paging)
462.875	Fremont Hotel (Paging)
462.900	Sands Hotel and Casino (Paging)
462.925	Showboat Hotel Inc (Paging)
462.925	Aladdin Hotel & Casino (Paging)
463.225	Union Plaza Hotel

463.250	El Cortez Hotel
463.325	Tropicana Hotel and Casino
463.375	Union Plaza Hotel & Casino
463.400	Caesars Palace Realty Corp
463.500	Gold Spike Hotel & Casino
463.575	Desert Inn Sub II Inc
463.575	Four Queens Hotel & Casino
463.600	Fitzgeralds Hotel Casino Engineering
463.600	Fitzgeralds Casino Hotel
463.625	Fitzgeralds Casino Hotel
463.650	Valley Inn
463.775	Stardust Hotel and Casino
463.825	Saddle West Casino Ltd
463.825	Ballys Grand Inc
463.900	Gold Coast Hotel & Casino
463.925	Fitzgeralds Hotel Casino Engineering
463.925	Fitzgeralds Casino Hotel
464.025	Binions Horseshoe
464.050	Binions Horseshoe
464.175	Lady Luck Casino & Hotel
464.225	Barbary Coast Casino
464.250	Holiday Casino Inc
464.275	Marina Hotel
464.325	Circus Circus Slots
464.375	Circus Circus
464.375	Hotel Nevada
464.425	Desert Inn Sub II Inc
464.425	Riviera Hotel & Casino
464.475	Mahoneys Silver Nugget
464.525	Caesars Palace Slots
464.575	Hilton Hotels Corporation
464.675	Stardust Slots
464.675	Desert Palace Inc
464.700	Sands Hotel and Casino
464.750	Barbary Coast Hotel
464.775	Sams Town Hotel and Casino
464.800	Casino Services Inc
464.800	Plaza Hotel & Casino
464.850	Four Queens Hotel & Casino
464.925	Four Queens Hotel & Casino
464.925	Desert Inn Sub II Inc
464.925	Bourbon Street Hotel & Casino
464.975	Hilton Hotels Corporation
464.975	El Rancho Hotel and Casino
465.000	Caesars Palace Hotel & Casino
465.000	Las Vegas Hilton
851.4375	Showboat Operating Company
851.5875	Barbary Coast Hotel & Casino
851.6875	Mirage Resorts Treasure Island
851.7125	Showboat Operating Company
851.7625	Frontier Hotel & Casino
851.9125	Palace Station Hotel and Casino
851.9375	Santa Fe Hotel Inc
851.9875	Showboat Operating Company
852.2875	Lady Luck Hotel Casino
852.6375	Mirage Hotel and Casino
852.6625	Riviera Hotel & Casino
852.6875	Mirage Resorts Treasure Island
852.9125	Palace Station Hotel and Casino
852.9875	Mirage Resorts Treasure Island
853.0875	Mirage Resorts Treasure Island
853.2875	Lady Luck Hotel Casino
853.4625	Circus Circus Enterprises Inc
853.5875	Circus Circus Enterprises Inc
853.6625	MGM Marina Inc
853.8125	Circus Circus Enterprises Inc
853.9125	Palace Station Hotel and Casino
853.9625	Santa Fe Hotel and Casino Inc
854.1375	Circus Circus Enterprises Inc
854.2875	Lady Luck Hotel Casino
854.4375	Sams Town Slots
854.5625	Frontier Hotel & Casino
854.5875	Santa Fe Hotel and Casino Inc
854.6375	Mirage Hotel and Casino Inc
854.8375	California Hotel & Casino
855.0375	Las Vegas Club
855.2875	Excalibur Hotel Casino
855.3375	Tropicana Hotel & Casino
855.5375	Fremont Hotel Security
855.5625	Frontier Hotel & Casino
855.5875	Tropicana Hotel & Casino
855.8125	Circus Circus Enterprises Inc
855.8375	Rio Suites Hotel and Casino
856.3625	Luxor Hotel Casino
856.8375	Sams Town Hotel and Casino
856.8625	Vacation Village Hotel and Casino
856.8875	Dunes Hotel
856.9125	Mirage Hotel and Casino Inc
857.3625	Luxor Hotel Casino
857.7875	Desert Inn Sub II Inc
857.8375	Desert Inn Sub II Inc
857.8875	Dunes Hotel
857.9125	Excalibur Hotel Casino
858.2875	Excalibur Hotel Casino
858.3625	Luxor Hotel Casino
858.7875	Desert Inn Sub II Inc
858.8875	Dunes Hotel
858.9125	Mirage Hotel and Casino Inc
859.3625	Luxor Hotel Casino
859.7875	Sands Hotel and Casino
859.8125	Mirage Hotel and Casino Inc
859.8375	Excalibur Hotel Casino
859.8875	Dunes Hotel
859.9125	Mirage Hotel and Casino Inc
860.3625	Luxor Hotel Casino
860.8125	Sam Boyds California Hotel and Casino
860.8375	Excalibur Hotel Casino
860.8875	Dunes Hotel
860.9125	Mirage Hotel and Casino Inc
929.0125	Desert Inn Sub II Inc (Paging)
929.0375	Mirage Resorts Treasure Island (Paging)
929.0625	Tropicana Hotel and Casino (Paging)
929.0875	Rio Vegas Hotel & Casino (Paging)
929.1125	Sahara Hotel & Casino (Paging)
929.1375	Golden Nugget Strip Corp (Paging)
929.1875	Palace Station Hotel & Casino (Paging)
929.2375	Holiday Casino Inc (Paging)
929.2875	Excalibur Hotel Casino (Paging)
929.5375	Circus Circus Enterprises Inc (Paging)
929.8375	Holiday Inn Hotel and Casino (Paging)
935.1375	Dunes Hotel and Country Club

(Frequencies from PerCon Corp. CD-ROM/(716) 386-6015)

In Review: The PRO-2026 Mobile Programmable Scanner

By Harold Ort, N2RLL

The PRO-2026 is designed as a mobile scanner, but with the addition of the optional AC adapter it's *also* a base scanner. To me, this is an important first point about this product because it has some extremely interesting features that shouldn't be overlooked if you're shopping for a base scanner.

Let's get right to the salient points of the PRO-2026; it's a 100-channel programmable scanner (five banks of 20 channels each) covering 29–50, 50–54, 108–137, 137–144, 144–148, 148–174, 406–450, 450–470, 470–512, 806–823.9375, 851–868.9375 and 896.1125–956 MHz.

What really makes this little gem unique is that it's also pre-programmed with current frequency limits for police, fire, marine, weather, and aircraft. Radio Shack calls this "service search." More about that later.

The PRO-2026 is powered by a 12-Vdc vehicle power cable (included) which plugs into the rear of the unit. Simply wire the other end to a switched power terminal that provides power only when you turn on your vehicle's ignition or accessory switch.

The antenna connection on the rear of the unit is the BNC type. You'll need to pick up a 278-117 (RF Adapter) if you're using the Radio Shack 20-012 All-Band Mag Mount Mobile Scanner Antenna or a 278-120 adapter if you're going to use the scanner with an antenna that terminates with a standard PL-239 coax connector.

Service Search

As the manual states, when you're using any of the pre-programmed service searches it will take the scanner a few minutes to search for activity through all the allotted frequencies. That's because the scanner searches ALL frequencies assigned to, for example, police—from the VHF low band all the way up through 900 plus MHz! That's a lot of area to cover quickly.

Spoiled as we are in this ultra-fast world, it might seem better to have two or three buttons for the "police" search function. A simple push of one of the buttons could then provide a quick search of one police band you're reasonably certain contains radio activity. Instead, it took the PRO-2026 about two and a half minutes to search the assigned police frequencies, returning to the lower search limit to begin the process all over. A big deal? No, not really, considering that the typical scanner user might only use the "service search" function when traveling or new to an area, or if he or she is without any frequency guide. Besides, experienced scanner users know to search in small limits. That way you're more likely to catch unpublished action since, within seconds, the scanner automatically tunes from a lower to upper search limit—a limit you've programmed.

The Radio Shack PRO-2026 Scanner can serve as both a mobile scanner and a base unit.

Never fear, the PRO-2026 is also user search-programmable. So, the automatic pre-programmed function, while it can be extremely useful, can also be augmented with your own search instructions. Searching is a great way to find those elusive frequencies when all else fails! This scanner also stores one new "find" in a monitor memory for later recall and transfer into the scanner's main memory for subsequent scanning.

Basic Operation

The PRO-2026 is super easy to set up and use. The operating manual gives you detailed vehicle mounting instructions written in plain English.

Programming the scanner is easy, too. A few simple key presses enters a frequency into memory for scanning. Controls are all front-mounted with the volume/squelch control thoughtfully positioned on the left, making it easier for a driver to locate. (Incidentally, never try programming this or any other scanner while driving. Pull to a rest area, or better yet, program the scanner before leaving your driveway. How many radio operators—that goes for hams, too!—have been involved in accidents while fiddling with push-buttons? Probably more than we realize!)

The unit is big on features. Take, for example, the continuous display light with numbers that are large and easy to see. Also included is a user-programmable delay feature and lockout button, now standard on most scanners. There's also a priority feature and, unlike some scanners, on the PRO-2026 you can select any channel for sampling every couple of seconds.

As with most scanners of this caliber, you can lockout banks, too. For example, let's say you've programmed your area police frequencies into Bank 1, fire/EMS into Bank 2, marine frequencies into Bank 3, etc., but there's some hot police activity going on in your town. Simply tell the scanner to only scan Bank 1 by pressing the other bank number keys (in this case 2–5) while in the scan mode. The scanner will then only scan the 20 frequencies in Bank 1—your programmed police frequencies.

The PRO-2026 as a Base Scanner

Remember I mentioned earlier that this is also an ideal base scanner? If only I had room in my shack for another electronic goodie! With enough channels (100) to easily cover your listening fare, whether you live in the big city or in the country, it's a great second scanner for someone who already owns a PRO-2006 or other mega-channel unit. Why not use the 2026 as a dedicated police/EMS, aircraft, or federal frequency scanner?

Never overlook the ease of operation and keyboard layout when buying a scanner. The PRO-2026 gets an "A" for including a solid flip-up stand that elevates the scanner for base use and another "A" for the way the designers tilted the entire front panel up slightly. It's these "go the extra mile" features that are so important!

How Well Does It "Hear"?

At my listening post in New Jersey, well south of Brooklyn, New York, I could easily tune the main Brooklyn fire frequency using only a magnetic-mount antenna attached to a nearby radiator. This was certainly not an elaborate or permanent set-up, but the PRO-2026 picked up those signals loud and clear nonetheless. What about overload from nearby transmitters? There was none. That's not to say, though, if you used the scanner in midtown Manhattan or other large city where there are more radio signals than people, you wouldn't experience overload/intermod. You might have to expect to hear all kinds of signals where they shouldn't be, just as with many other scanners.

Moreover, connecting the PRO-2026 to my outside 2-meter/70cm amateur antenna produced outstanding results, particularly in the 154 MHz and higher bands. On the road, using the Radio Shack All Band Mag Mount Mobile Scanner Antenna (20-012) that covers 25–1300 MHz, the PRO–2026 scanner performed very well indeed. I could still hear the Brooklyn fire department and other fairly distant stations with ease. (Just remember, some states don't allow mobile scanning, so be sure to check first!)

The audio is crisp and clean; no harsh or raspy tones with this scanner. Do you want more audio or even better sound? Try the extension speaker (21-549) or even the amplified speaker (21-541). You probably really won't need to use either, because the 1.1-watt (max.) audio is powerful enough.

The Bottom Line

All-in-all, the PRO-2026 gives you the best of both worlds: an easy-to-use, compact unit for mobile operation or a great scanner for home use (with optional adapter, 273-1652). Test drive one at your store today! ■

Middle Eastern Voices

It's an area that's always in a state of change and upheaval—and it's yours for the tuning on shortwave!

By Gerry L. Dexter

The Middle East has been a global sore spot for more years than most people have even been around. It's a patchwork, a quilt of pain and problems. It's Arabs versus Israel...Moslem versus Jew...Shiite versus Sunni, the Palestinians, and the PLO...Lebanon versus itself...Iran versus Iraq...Iraq versus everybody else. Not to mention hostages, terrorists, and the occasional war—all these tensions have kept the area on our front pages for decades.

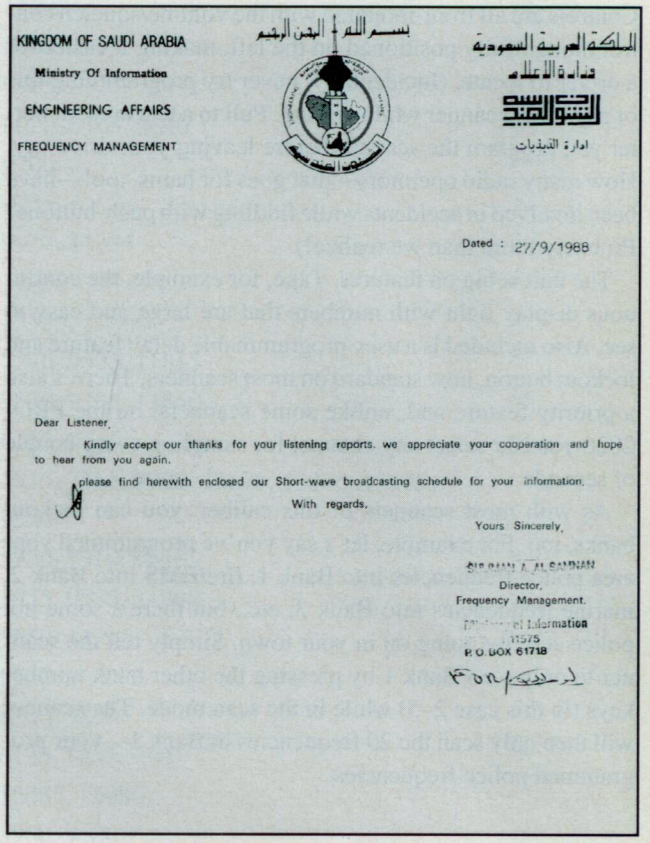
But you can get even closer than the front-page stories. Your shortwave radio can take you right into the capitals of these nations! This article will provide you with a guidebook to Middle East listening.

What to Tune

There are relatively few English-language broadcasts coming from the Middle East, and even fewer aimed at listeners in the U.S. That's a bit surprising considering the long-term involvement the U.S. has had in Middle Eastern affairs. Moreover, many of the stations do not air *any* language except Arabic on shortwave, even though they may have a local English-language medium wave or FM channel!

As is always the case with shortwave broadcasting, times and frequencies used tend to change (sometimes often), and with little or no notice. The best you can do, then, is use the following information, accurate at the time it was prepared, and hope not too many changes have taken place in the meantime. You can write to the stations for free program and frequency schedules, although not all will answer your request.

Times are given in Coordinated Universal Time (UTC), which is five hours ahead of Eastern Standard Time (i.e., 0000 UTC equals 7 p.m. EST, 6 p.m. CST, 5 p.m. MST and 4 p.m. PST).



KINGDOM OF SAUDI ARABIA
Ministry Of Information
ENGINEERING AFFAIRS
FREQUENCY MANAGEMENT

بسم الله الرحمن الرحيم

المملكة العربية السعودية
وزارة الاعلام
ادارة التبديدات

Dated : 27/9/1988

Dear Listener,

Kindly accept our thanks for your listening reports. we appreciate your cooperation and hope to hear from you again.

please find herewith enclosed our Short-wave broadcasting schedule for your information.

With regards.

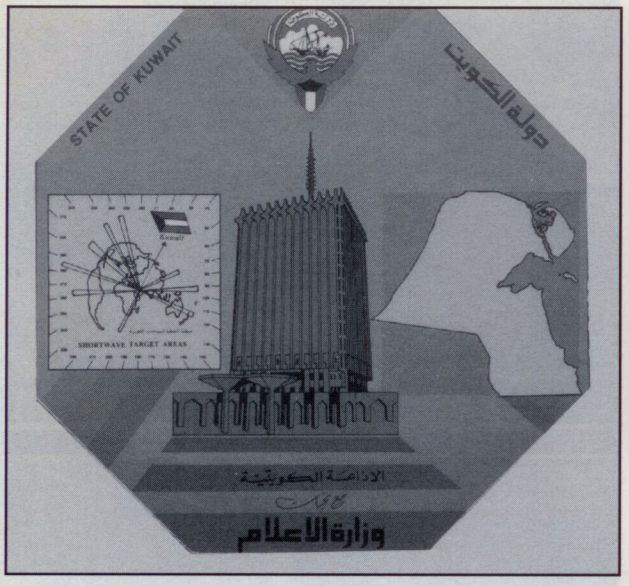
Yours Sincerely,

Director,
Frequency Management.

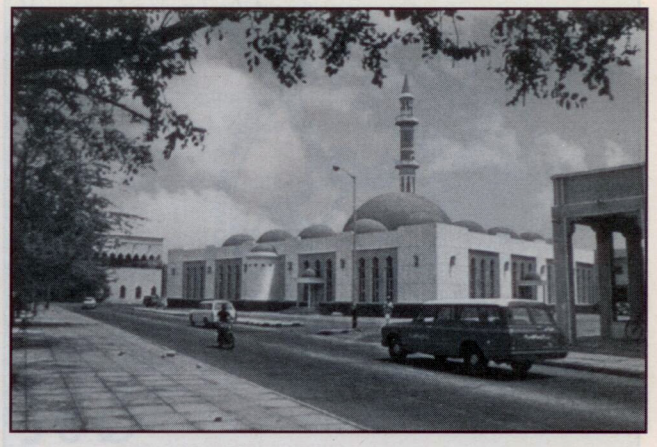
P.O. BOX 61718

This letter confirms reception of the Saudi Arabian government station.

Bahrain—Radio Bahrain shows up first on our alphabetical list, and it also holds first place in the "difficult to hear" sweepstakes. It's a somewhat easier catch if you live in the eastern part of North America, but it's darn tough in the west and midwest. Radio Bahrain (Bahrain Broadcasting) runs 60 kilowatts on 6010 and 9745 kHz; the latter is usually closer to 9746 kHz. The station signs on at 0300 and runs straight through to 2115 (sign off is a few minutes earlier on 6010). Most U.S. loggings have occurred around 1200 and 1300 or an hour or so before sign off. All programming is in Arabic. Reception reports go to P.O. Box 702, Manama, Bahrain. The wait for a QSL is often a long one.



This octagonal card shows Radio Kuwait's building and coverage area, plus an outline map of the country. Radio Kuwait has been on the air since 1951.

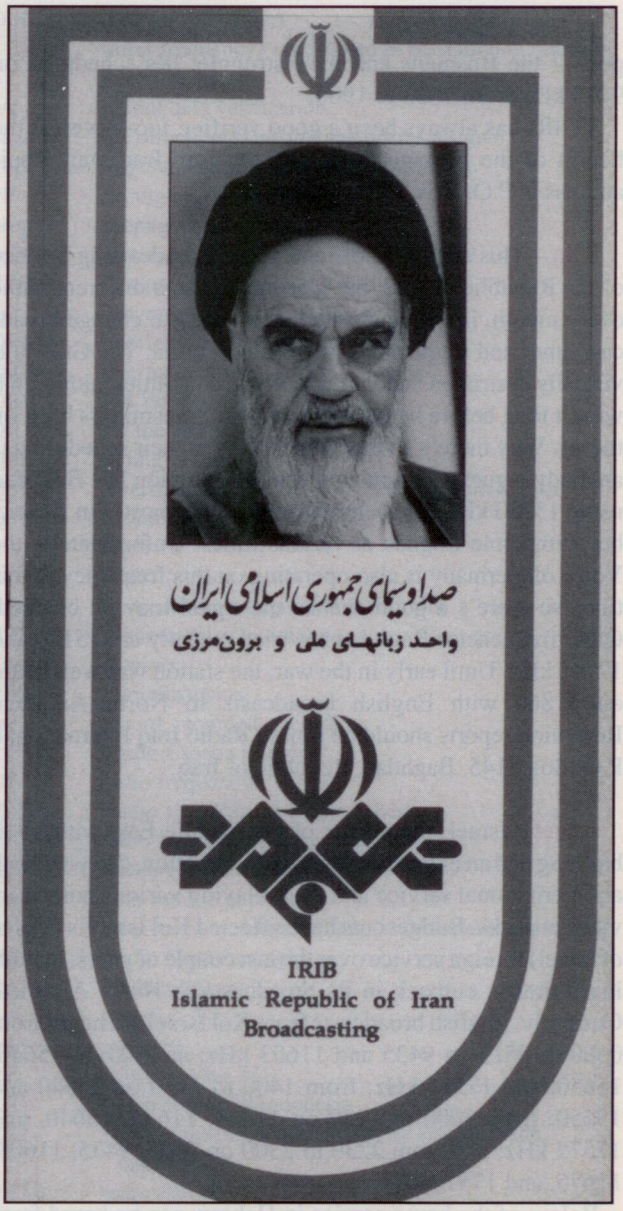


This reply from Qatar pictures the Grand Mosque in Doha.

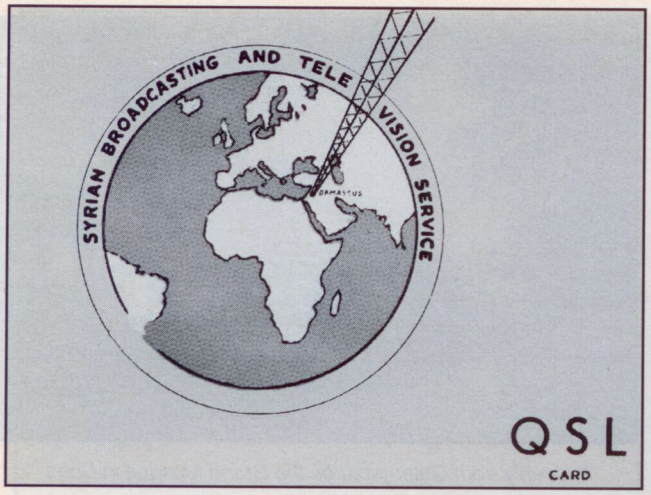
Egypt—The government station, Radio Cairo, is one of the more stable of the Middle Eastern broadcasters and has provided continuous service at pretty much the same times and frequencies for many years. Unfortunately, the station cannot seem to fix its poor modulation problem. As a result, you need a nice strong signal to play with in order to make the content more understandable. Radio Cairo has a nightly English broadcast for North America at 0200 to 0330 on 9475 and 11600 (the former is heard best). The station also broadcasts in a variety of other languages, from Afar to Zulu, and relays several other domestic program services as well. These include the *General Program* on 9770, 9800, or 12050 kHz most hours; the *Voice of the Arabs* on 9850 between 0300 and 0600; and the *Holy Quran Program*, aired on 9755 from 0200 to 2200. QSL cards from Radio Cairo come from P.O. Box 1186, Cairo, Egypt.

Iran—The Voice of the Islamic Republic of Iran (VOIRI) has always been a pretty easy mark on its 15084 channel. No one else uses that oddball frequency, so when you hear a signal there you can be 99.99 percent sure it's VOIRI. If 19 meters is "open," chances are the station will be heard, assuming it's on the air. It won't be in English, though. For that, you have to tune elsewhere and at more specific times. Iran has long aired an hour's worth of English programming at 1930 on 9022 kHz. The addition of new transmitters has brought a second channel into use, although it seems to get changed quite frequently. As this is written, 11965 is being used, but if you don't find it there, try 11790 or 11910 kHz. Another broadcast to North America is scheduled from 0030 to 0130 on 7100 and 9022 kHz.

A current shortwave curiosity is a program called *The Voice of Bosnia* which VOIRI is airing in Bosnian in sup-



At one time the Voice of the Islamic Republic of Iran sent out stickers featuring Ayatollah Khomeini's picture.



A QSL from Radio Damascus can be difficult to obtain.

port of the Bosnians and their struggle. It's scheduled on 9745 kHz from 1830 to 1900.

VOIRI has always been a good verifier, too—even at the height of the hostage crisis and the Iran-Iraq war. Their address is P.O. Box 3333, Tehran.

Iraq—This station is, officially, the Broadcasting Service of the Republic of Iraq, but it seems to use a different name every month, in keeping with its tendency to change broadcast times and frequencies just about as often. The Gulf War virtually destroyed Saddam's shortwave facilities, although it wasn't long before he got some big gun transmitters back on the air. Why there's so much instability in their scheduling is anybody's guess. The most recent information has Baghdad using 13780 kHz between 0900 and 1150, mostly in Arabic, but with some English at various times. Unfortunately, the Voice of Germany is also operating on this frequency at this time, so there's a good chance the signal may be blocked. Other frequencies Baghdad has tried recently are 15180 and 17740 kHz. Until early in the war, the station was well heard on 11860 with English broadcasts to North America. Reception reports should be sent to Radio Iraq International, P.O. Box 8145, Baghdad, Republic of Iraq.

Israel—Israel, the vortex of the Middle East whirlpool, has long had an extensive shortwave operation, carrying both an international service and also relaying various home service networks. Budget cuts have affected Kol Israel's (Voice of Israel) foreign service over the last couple of years, including a drastic cutback in its broadcasts to North America. Currently, English broadcasts from Kol Israel are heard from 0500 to 0515 on 9435 and 11603 kHz; at 1100 on 15640, 15650, and 17575 kHz; from 1400 to 1430 on 15640 and 15650; from 2000 to 2230 on 11603, 11675, 15640, and 17575 kHz; and from 2230 to 2300 on 7465, 9435, 11603, 11675, and 17575 kHz.

Relays of the home service in Hebrew can be heard from 0400 to 2300 on 13750 and 15615, from 0400 to 0610 on

VOIRI was sending this QSL during the Iran-Iraq war. The caption on the back reads "War is ugly, but to be dominated by aliens is still uglier."

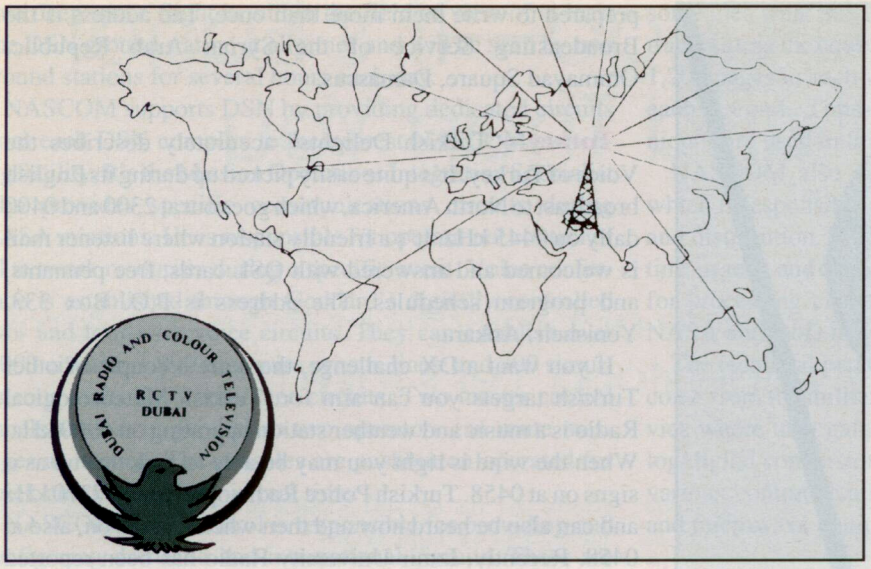
11590, from 0615 to 1355 on 17545, and from 1430 to 0700 on 9388 kHz.

Send your reception reports to P.O. Box 1082, 91010 Jerusalem, Israel.

Jordan—Officially now at peace with Israel, the Kingdom operates its Radio Jordan on shortwave, although the programming consists simply of relays of domestic radio. English is aired on 9560 kHz between 1200 and 1300 and 1500 and 1730. You may find reception is better on the Arabic language broadcasts. Try 9830 kHz between 1800 and 2100, or 11940 which runs half an hour later.

Radio Jordan can be QSLed, but getting it done is usually a real test of your patience and persistence. Reports go to The Director, P.O. Box 909, Amman.

Kuwait—Radio Kuwait was taken over by the Iraqis when they invaded, then bombed off the air by the U.S. But a year or so after the war ended, new transmitters were installed and Radio Kuwait was being heard again. English to Europe and North America airs from 1800 to 2100 on 13620 kHz. Other broadcasts are in Arabic on frequencies such as 9840, 11665, 11990, 15495, 15505, 17895, and 21675 kHz at various times. Radio Kuwait operates 24 hours-a-day on shortwave on one frequency or another. The station is a reliable verifi-



UAE Radio's QSL from Dubai. The map is drawn in black, the insignia in black, blue, green, red, and brown.

er of reception reports. Mail yours to P.O. Box 193, 13002 Safat, Kuwait.

Lebanon—This country is something of a rarity in Middle East broadcasting because it has more than one shortwave station but no official government shortwave station. It's also one of the harder to hear. A U.S. shortwave missionary broadcaster based in California, High Adventure Ministries, operates the King of Hope from Southern Lebanon on 6280 kHz. The 10-kilowatt transmitter signs on at 0500 and runs until 2200 in English, Arabic, Russian, and various East European languages. More easily heard is its sister station, Wings of Hope, which operates with 25 kW on 11530, also from 0500 to 2200. Reports should go to P.O. Box 3379, Limassol, Cyprus or High Adventure Ministries, P.O. Box 7466, Van Nuys, CA 91409.

Another station is the Radio Voice of Lebanon, which doesn't seem to be consistently active. It is supposed to operate on 6550 kHz with a 24-hour schedule, mostly in Arabic. Your best chance for this station is during the later evening hours. Reports go to P.O. Box 165271, Ashrafieh, Beirut.

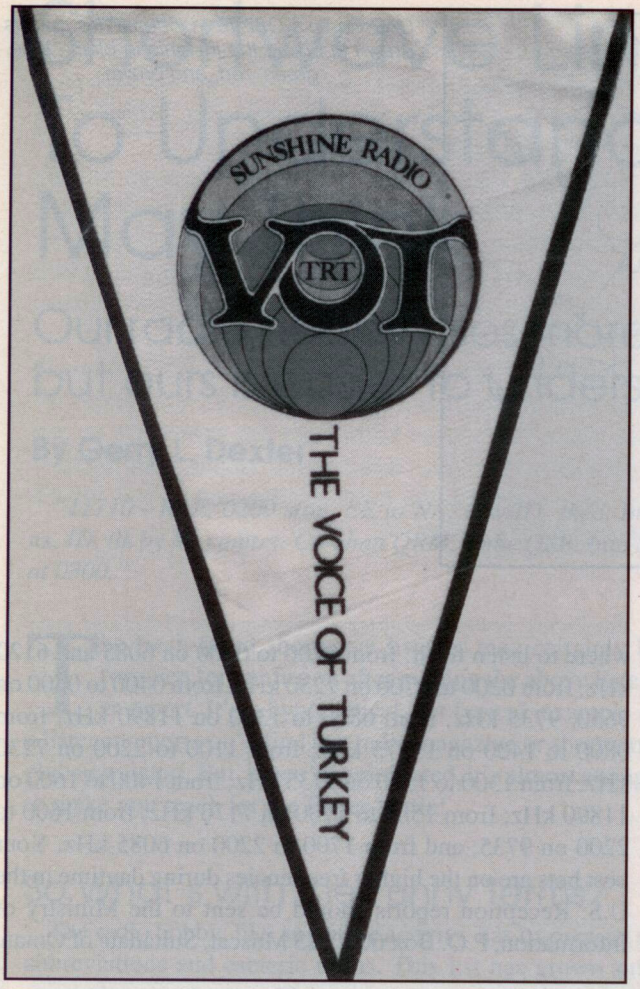
Libya—Some years ago Qadaffi's government radio had a regular, and quite well-heard, English service to North America. For one reason or another, the Colonel gave that up. Indeed, the whole shortwave operation seems to have been cut back in recent years. Arabic is all you can hear from Libyan Jamahiriya Broadcasting these days. The home service operates from 0500 to 2350 on 6155, 6185, 9600, and 11815 kHz. Another service, The Voice of the Great Homeland, is on from 1115 to 1315 and 1745 to 0400 on 15235, 15415, and 15435 kHz. These are perhaps the easiest to hear. Reports go to Box 9333, Soug al Jama, Tripoli.

Oman—Forget about hearing any English from Radio Oman; the station is and always has been an all-Arabic broadcaster, at least on the shortwave bands. Here's when and where to listen for it: from 0200 to 0400 on 6085 and 6120 kHz; from 0200 to 0700 on 7230 kHz; from 0400 to 0800 on 9650, 9735 kHz; from 0800 to 1300 on 11890 kHz; from 0800 to 1400 on 15375 kHz; from 1100 to 2200 on 7230 kHz; from 1300 to 1500 on 9735 kHz; from 1400 to 1600 on 11890 kHz; from 1500 to 1700 on 7170 kHz; from 1600 to 2200 on 9735; and from 1700 to 2200 on 6085 kHz. Your best bets are on the higher frequencies during daytime in the U.S. Reception reports should be sent to the Ministry of Information, P.O. Box 600, 113 Muscat, Sultanate of Oman.

Palestine—Yasir Arafat and his PLO are just beginning the long and difficult job of nation building. So far, there are no shortwave broadcasts, only two medium wavers: the Voice of Palestine on 675 kHz and Palestine Radio and TV on 894 kHz. Don't bother trying for these unless you happen to be in the neighborhood. As far as we know, the *Voice of Palestine* program is still being carried by Algerian Radio from 1800 to 1900 on 9510, 11715, 15205, and 17745 kHz.

Qatar—The Qatar Broadcasting Service is another broadcaster mostly concerned with speaking to its neighbors via shortwave. Thus, it sees no need to broadcast in any language other than Arabic. The Qatar Broadcasting Service operates from 0245 to 0700 on 9665 and 11820 kHz; from 0700 to 1300 on 21555 kHz; from 1300 to 1700 on 17800 and 21555 kHz; and from 1700 to 2130 on 9665 kHz. The address for reports is P.O. Box 3939, Doha, Qatar.

Saudi Arabia—Given Saudi Arabia's wealth, stability, and friendship with the U.S., many shortwave listeners wonder why the Broadcasting Service of the Kingdom of Saudi Arabia doesn't have an English language broadcast to North America. What English is aired is at an inopportune time for reception here (1600 to 2100 on 9705, which just doesn't work well for us). The Arabic language *General Program* operates from 0600 to 2300 on 9555, 9870, 11710, 11780,



The Voice of Turkey often favors its listeners with colorful pennants.

11820, 11950, 15060, 15175, 15380, and 15435 kHz. Not all of these are in use at any one time, of course. Try 15060 kHz between 1200 and 1500. The *Second Program* is less audible, scheduled at 0300 to 1700 on 9580 and at 1700 to 2100 on 6020 kHz. The *Holy Quran* program is scheduled between 0300 and 0600 and 0900 to 2100 on 9555, 9665, 9685, 9730, 9885, 11710, 11740, 11835, 11895, 11935, 15165, 15280, and 21495 kHz. Again, as few as two of these frequencies may be in use at any one time.

The *Call of Islam* airs between 1500 and 1700 on 11780, 11950, and 11965 kHz. Send reports in care of the Frequency Manager, BSKSA, Ministry of Information, Riyadh.

Syria—Radio Damascus airs two one-hour English language segments, one beamed to Europe, the other to America. The European release comes on at 2005 on 12085 and 15095 kHz. There's a five-minute break at 2105 before the broadcast to America starts at 2110 on the same frequencies. French, German, Portuguese, Spanish, and Russian broadcasts are also aired on these channels. Damascus also uses 9950 and 9995 kHz at various times. The station is an erratic verifier, to put it mildly. If you really want a QSL card be prepared to write them more than once. The address is the Broadcasting Service of the Syrian Arab Republic, Ommayad Square, Damascus.

Turkey—"Turkish Delights" accurately describes the Voice of Turkey. It's quite easily picked up during its English broadcast to North America, which goes out at 2300 and 0400 daily on 9445 kHz. It's a friendly station where listener mail is welcomed and answered with QSL cards, free pennants, and program schedules. The address is P.O. Box 333, Yenisheir, Ankara.

If you want a DX challenge, there are a couple of other Turkish targets you can aim for. Turkish Meteorological Radio is a music and weather station operating on 6900 kHz. When the wind is right you may be able to pick this up as it signs on at 0458. Turkish Police Radio operates on 7370 kHz and can also be heard now and then when it signs on, also at 0458. Recently, Izmir University Radio has been reported active, using 7100 between 0700 and 0800. You'll treat yourself to something special if you manage to hear this one.

United Arab Emirates—Two different government stations are on the air from the UAE, and both of them have English broadcasts for North America. Radio of the UAE (also known as the Voice of the UAE) operates from Abu Dhabi with English to North America from 2200 to 0000 on 9770, 11885, and 13605 kHz. Reports go to the Director of Foreign Programs, Radio of the UAE, P.O. Box 63, Abu Dhabi.

UAE Radio and Television operates from Dubai, and its service for this continent airs at 0230 to 0400 on 11945, 13695, and 15400 kHz. The station also has English at 1330 on 13675 kHz and at 1800 on 15395 kHz. Reports go to P.O. Box 1695, Abu Dhabi. Both stations are pretty reliable in the QSL department.

Yemen—North and South Yemen had a long and bitter civil war years ago, then unified. The country recently split again after another civil war. During unification the two main broadcast centers, in San'a and Aden, worked in concert. The Aden facility was reportedly destroyed in the recent war, so only broadcasts from San'a are on the air at the moment. There's supposed to be an English broadcast from Yemen Radio at 1800 on 9780 kHz (actually 9779 and a fraction). Your best bet, however, is the sign-on at 0300 on 9780 in Arabic. Even so, reception of Yemen Radio is erratic. Yemen has never been a reliable verifier, and considering the recent troubles there, it is probably less so now. It's worth a try, though. Send reports to P.O. Box 2182, San'a, Republic of Yemen.

Now Sit Back and Enjoy

If you spend a fair amount of time and practice some patience, it's very likely you can manage to take a complete tour of the Middle East. You won't need airplane tickets or ship accommodations, just your trusty shortwave set and a sharp pair of ears. Good listening! ■

Clear Channel AM Stations

Where to find AM's "Easy Listening."

By Chuck Gysi, N2DUP

For many of us, the term AM radio conjures up vague but fond memories of crackling voices and popular music coming from far off over the old console or transistor radio. While you may not have given them much thought recently, those voices and that music are still out there, just waiting to be heard.

No matter where you live in North America, it's possible to receive AM radio stations from across the continent. It doesn't take fancy or expensive equipment either. Your kitchen radio is all you need to rediscover the simple delights of AM's clear channels.

Clear channels are certain frequencies on the AM broadcast band that have been set aside for wide area broadcasting at night. At night, only a few stations, sometimes only one, will be using one of these 60 channels. This allows a station to serve a wider area for at least part of the day, particularly areas that aren't served by other stations. If you live on the East Coast, you'll be able to hear stations from New York, Pennsylvania, Virginia, Ohio, West Virginia, Canada, and more. If you live on the West Coast, you'll be able to hear stations in California, Oregon, Washington, New Mexico, Nevada, Canada, and Mexico.

These powerhouse stations transmit with the maximum power allowed in the U.S. and Canada—50,000 watts, all day and night. Outside the U.S. and Canada, some stations may transmit with even higher power—as much as 100,000 watts and more. While there may be other daytime-only stations that also use the clear channels during the day, they are off the air at night and allow listeners to hear the clear channel powerhouses from faraway places. Some of these stations even cater to their listeners from afar—for instance, WWVA in Wheeling, West Virginia, caters to truckers by playing country music and offering weather reports for interstate highways.

In addition to clear channels, there are also regional and local channels on the AM broadcast band. While the clear channels will be the easiest to hear, some regional channels can also be heard at night. These stations serve a wide area and usually have medium power of 5,000 or 10,000 watts. Local stations typically serve much smaller areas, usually one community, and may transmit with a power between 250 and 1,000 watts. It is much harder to hear stations on local channels because there are so many. Usually only experienced broadcast band DXers try to tune in these local stations. For instance, there could be as many as a dozen on the same frequency in a given state.

Here's a listing of AM stations that broadcast on clear channels. These stations can be heard over large portions of the U.S. and Canada at night. All stations transmit with the maximum allowed 50,000 watts, both day and night. While clear channels are listed for the U.S., Mexico, Canada, Cuba, and the Bahamas, stations' call letters are provided for the U.S. and Canada only.

Freq.	Station
530	CANADIAN CLEAR
540	CANADIAN CLEAR
	CBK Regina, Saskatchewan
640	CLEAR
	KFI Los Angeles, California
	CHOG Richmond Hill, Ontario
650	CLEAR
	WSM Nashville, Tennessee
	KYAK Anchorage, Alaska
660	CLEAR
	WFAN New York, New York
	KTNN Window Rock, Arizona
	CFFR Calgary, Alberta

Freq.	Station
670	CLEAR
	WMAQ Chicago, Illinois
	KBOI Boise, Idaho
680	CLEAR
	KNBR San Francisco, California
	WPTF Raleigh, North Carolina
	CJOB Winnipeg, Manitoba
	WRKO Boston, Massachusetts
	CFTR Toronto, Ontario
690	CANADIAN CLEAR
	CBU Vancouver, British Columbia
	CBF Montreal, Quebec
700	CLEAR
	WLW Cincinnati, Ohio
710	CLEAR
	WOR New York, New York
	WAQI Miami, Florida
	KIRO Seattle, Washington
720	CLEAR
	WGN Chicago, Illinois
	KDWN Las Vegas, Nevada
730	MEXICAN CLEAR
	CKLG Vancouver, British Columbia
	CKAC Montreal, Quebec
740	CANADIAN CLEAR
	KTRH Houston, Texas
	KCBS San Francisco, California
	CBX Edmonton, Alberta
	CBL Toronto, Ontario
750	CLEAR
	WSB Atlanta, Georgia
	KFQD Anchorage, Alaska
760	CLEAR
	WJR Detroit, Michigan
770	CLEAR
	KKOB Albuquerque, New Mexico
	WABC New York, New York
	CHQR Calgary, Alberta
780	CLEAR
	WBBM Chicago, Illinois
	KROW Reno, Nevada
800	MEXICAN CLEAR
	CKLW Windsor, Ontario
	CHRC Quebec City, Quebec

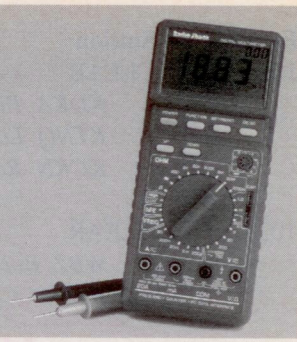
Freq.	Station
810	CLEAR
	KGO San Francisco, California
	WGY Schenectady, New York
	WKVM San Juan, Puerto Rico
820	CLEAR
	WBAP Fort Worth, Texas
	KCBF Fairbanks, Alaska
830	CLEAR
	WCCO Minneapolis, Minnesota
840	CLEAR
	WHAS Louisville, Kentucky
850	CLEAR
	KOA Denver, Colorado
	WHDH Boston, Massachusetts
860	CANADIAN CLEAR
	CJBC Toronto, Ontario
870	CLEAR
	WWL New Orleans, Louisiana
	KAIM Honolulu, Hawaii
880	CANADIAN CLEAR
	WCBS New York, New York
	KRVN Lexington, Nebraska
	CHQT Edmonton, Alberta
890	CLEAR
	WLS Chicago, Illinois
900	MEXICAN CLEAR
	CHML Hamilton, Ontario
940	MEXICAN CLEAR
	KFRE Fresno, California
990	CANADIAN CLEAR
	CBW Winnipeg, Manitoba
	CKIS Montreal, Quebec
1000	U.S. AND MEXICAN CLEAR
	WLUP Chicago, Illinois
	KOMO Seattle, Washington
1010	CANADIAN AND CUBAN CLEAR
	WINS New York, New York
	CBR Calgary, Alberta
	CFRB Toronto, Ontario

Freq.	Station
1020	CLEAR
	KDKA Pittsburgh, Pennsylvania
	KTNQ Los Angeles, California
	KCKN Roswell, New Mexico
1030	CLEAR
	WBZ Boston, Massachusetts
	KTWO Casper, Wyoming
1040	CLEAR
	WHO Des Moines, Iowa
1050	MEXICAN CLEAR
	WEVD New York, New York
1060	U.S. AND MEXICAN CLEAR
	KYW Philadelphia, Pennsylvania
	CFCN Calgary, Alberta
1070	U.S. AND CANADIAN CLEAR
	KNX Los Angeles, California
	CBA Moncton, New Brunswick
1080	CLEAR
	KRLD Dallas, Texas
	WTIC Hartford, Connecticut
1090	U.S. AND MEXICAN CLEAR
	KAAY Little Rock, Arkansas
	WBAL Baltimore, Maryland
	KING Seattle, Washington
1100	CLEAR
	WWWE Cleveland, Ohio
	KFAX San Francisco, California
1120	CLEAR
	KMOX St. Louis, Missouri
	KPNW Eugene, Oregon
1130	U.S. AND CANADIAN CLEAR
	WBBR New York, New York
	KWKH Shreveport, Louisiana
	CKWX Vancouver, British Columbia
1140	U.S. AND MEXICAN CLEAR
	KRAK Sacramento, California
	WRVA Richmond, Virginia
	CFXL Calgary, Alberta
1160	CLEAR
	KSL Salt Lake City, Utah
1170	CLEAR
	WWVA Wheeling, West Virginia
	KVOO Tulsa, Oklahoma
1180	CLEAR
	RADIO MARTI Marathon Key, Florida
	WHAM Rochester, New York
1190	U.S. AND MEXICAN CLEAR
	WOWO Fort Wayne, Indiana
	KEX Portland, Oregon
1200	CLEAR
	WOAI San Antonio, Texas
	CKDA Victoria, British Columbia
	CFGO Ottawa, Ontario
1210	CLEAR
	WOGL Philadelphia, Pennsylvania
1220	MEXICAN CLEAR
	WKNR Cleveland, Ohio
1500	CLEAR
	WTOP Washington, D.C.
	KSTP St. Paul, Minnesota
1510	CLEAR
	WSSH Boston, Massachusetts
	WLAC Nashville, Tennessee
	KGA Spokane, Washington
1520	CLEAR
	KOMA Oklahoma City, Oklahoma
	WWKB Buffalo, New York
1530	CLEAR
	KFBK Sacramento, California
	WCKY Cincinnati, Ohio
1540	BAHAMAS CLEAR
	KXEL Waterloo, Iowa
	WPTR Albany, New York
1550	MEXICAN CLEAR
1560	CUBAN CLEAR
	WQEW New York, New York
1570	MEXICAN CLEAR
	CKLM Laval, Quebec
1580	CANADIAN CLEAR
	KBLA Santa Monica, California
	KCWW Tempe, Arizona
	CBJ Chicoutimi, Quebec

THE PARTS PLACE SM

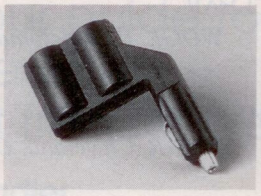
Multimeter/counter with PC interface

Dual-display LCD digital meter measures AC/DC voltage, capacitance and transistor gain, frequencies to 20 MHz. Includes MS-DOS/Windows® compatible software on 3½" disk. #22-168 ..... **129.99**

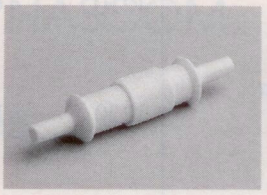


Big values in tools, test equipment, parts and accessories

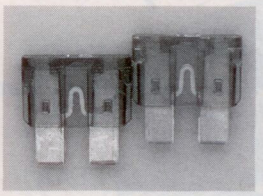
AC Voltage Sensor. No direct hookup required—safe way to check cords, switches, fuses, more. Indicates 70 to 440VAC. #22-103 ..... **12.99**



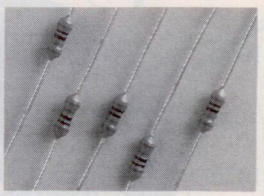
Modular 2-Outlet 12VDC Adapter. Power two 12VDC-operated devices with lighter-style plugs from one vehicle lighter outlet. #270-1525 ... **6.99**



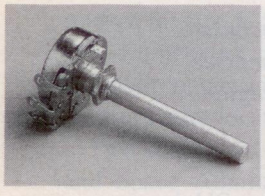
Inline Fuse Holder for Glass Fuse. For fuse rated up to 20 amps. Dozens more items for mobile radio installations available! #270-1211 .. **1.19**



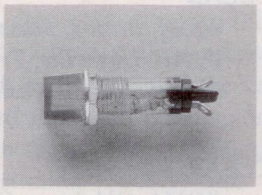
Blade-Type Automotive Fuse Kit. Includes one each of the most popular sizes: 5, 7.5, 10, 15 and 20 amps. #270-1201 .. **Set of 5/1.99**



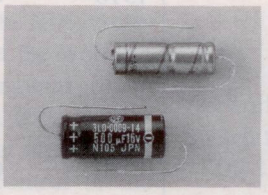
¼-Watt Metal-Film Resistor Assortment. Collection includes 50 pieces of 12 values from 10 ohms to 1 megohm. 1% tolerance. #271-309 ..... **2.29**



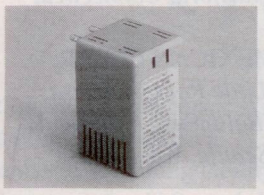
100k-Ohm Linear-Taper Potentiometer. For your projects and repairs. Has 6mm-diameter shaft suitable for ¼" applications. 271-092 ..... **1.29**



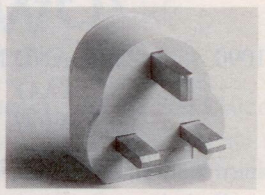
12-Volt Red Neon Lamp Assembly. Long-lasting, super-bright—excellent for use as a pilot light. Fits 7/16" mounting hole. #272-704.. **Pkg. of 2/1.99**



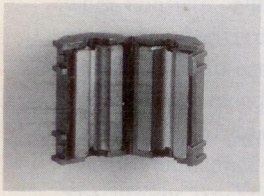
Electrolytic Capacitor Assortment. Includes mini and submini sizes in a variety of styles, rated up to 50WVDC. #272-802, **Set of 20/2.29**



240V-to-120V Foreign Travel AC Converter. For electronic/motorized devices rated to 50W, heating devices rated to 1600W. #273-1410 ..... **34.99**

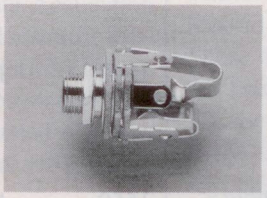


Foreign AC Converter Plug Adapters. Use with most outlets, including recessed. Must be used with a converter. #273-1405, **Set of 4/7.99**



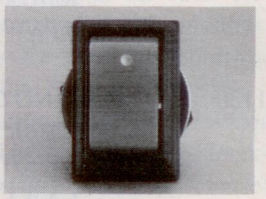
Snap-Together Ferrite Core. Cuts radio frequency transmission/pickup. Snaps over computer and AC cables, audio leads, coax. #273-105..... **5.49**

¼" Mono to 1/8" Stereo Plug Adapter. Connect lightweight stereo phones with 1/8" plug to monaural audio equipment having ¼" jack. #274-348 .. **2.49**



¼" Open-Frame Stereo Jack. Three-conductor open-circuit jack for project building and audio equipment repairs. #274-312, **Pkg. of 2/2.79**

Gold-Plated Phono Plug Coupler. Ideal for linking A/V patch cords. Gold ensures secure hookup and superior signal transfer. #274-874 ..... **1.99**



Heavy-Duty SPST Rocker Switch. Rated 6 amps at 125VAC. Mounts in 3/4" hole. In stock today—see before you buy at The Shack! #275-690 .... **1.99**

Enjoy speedy service and low prices on thousands of items

- ***Semiconductors and ICs*** ■ ***Hard-to-find batteries***
- ***CB and scanner crystals*** ■ ***Long-life vacuum tubes***
- ***Phono cartridges/styli*** ■ ***SAMS® service books***

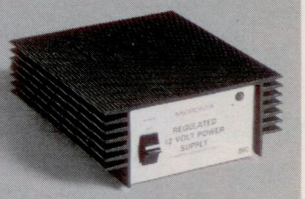
Why pay more for mail-order? Your Radio Shack stocks more than 1000 electronic components, and another 15,000 are available fast from our special-order warehouse. Ordering is easy—give us the exact part number (or just bring in the old part). We'll check availability and order by phone. Delivery time to your nearby Radio Shack for most items is just a week.

Digital logic probe with "beep" tones

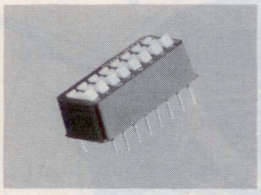
Spots problems in PCs and digital circuits. Color-coded LEDs indicate high, low and pulsed logic states, while tones free your eyes for faster testing. Trouble-shooting manual. #22-303 . . . **17.99**

Power your mobile radio from home AC

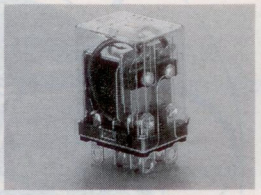
This 120VAC-to-12VDC regulated power supply is ideal for operating mobile CBs, Ham rigs and car stereos from AC. Great for trouble-shooting, too. Heat sink. 2.5 amps continuous. #22-120 . . . **39.99**



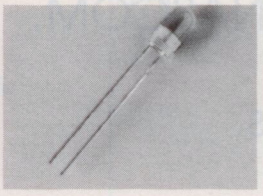
There are 6500 Radio Shack stores and dealers to serve you



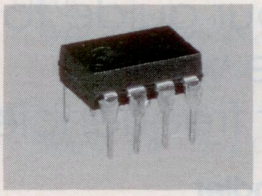
8-Position DIP Switch. For digital and low-current uses. Plugs into standard 16-pin integrated circuit socket. #275-1301 . . . . . **1.79**



4PDT Relay. Contacts: 3A at 125VAC. Coil: 12VDC, 130mA, 150 ohms. With specs, internal schematic, pin-out diagram. #275-214 . . **5.99**



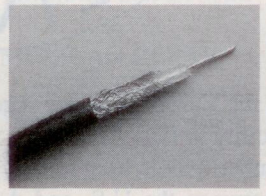
Bargain LED Assortment. For bright ideas. May include MV-series, red, green, amber and IR emitters. #276-1622, **Set of 20/2.29**



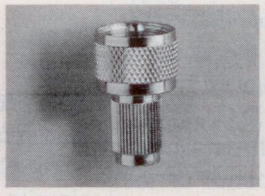
LM3909 8-Pin DIP LED Flasher. Flashes LED with a minimum of support parts. Operates on single-cell (1.5VDC) power. #276-1705 . . . **1.69**

Getting Started in Electronics. Perfect hands-on introduction to a fascinating subject by Forrest Mims III. 128 pages, illustrated. #276-5003 . . **2.99**

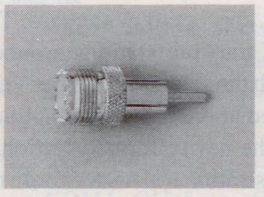
Mini Audio Amp With Built-In Speaker. Many uses—test amp, signal tracer, phone amp and amplified PC speaker. #277-1008 . . . . . **11.99**



RG-58 Shielded Coaxial Cable. Preferred for Ham, CB, scanner hookups. Low-loss design, all-copper conductors. #278-1314 . . . . . **Foot/22¢**

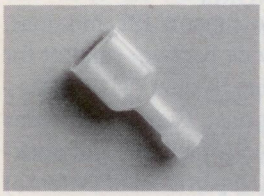


No-Crimp Solderless PL-259 Plug. Popular connector for use on RG-58 cable. Installs with a flat-blade screwdriver. #278-186. . . . **3.29**

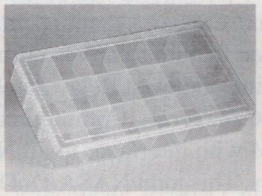


"Scanner" Adapter. Connects coaxial cable having a PL-259 plug to the Motorola-type jack found on many scanners. #278-208 . . . . . **1.99**

14-Piece PC Tool Kit. Slot and Phillips drivers, chip extractor and inserter, nutdriver, tweezers, parts tube and carry case. #64-1972 . . . . . **14.99**

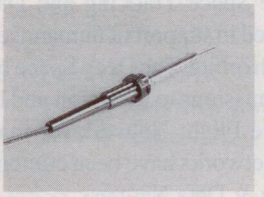


Insulated Female Quick Disconnects. Conveniently color-coded red for 22-18 AWG wire. Two each of .250", .187" and .110". #64-3058 . . **Pkg. of 6/1.39**



Parts Storage Box. Handy $8^1/_2 \times 4^3/_4 \times 1^1/_2$" clear plastic box features six compartments, with dividers to create 18. #64-552 . . . . . **3.19**

High-Strength Electrical Tape. Moisture-resistant and flame-retardant. Has tough 7-mil backing, withstands 0 to 220° F. $^3/_4$" × 66-ft. roll. #64-2352, **3.49**



30-Watt Mobile Soldering Pencil. Ideal for car accessory and stereo wiring jobs. Plugs into lighter socket, uses 12VDC. #64-2105 . . . . . **5.99**

.062" Rosin-Core Solder. For reliable connections in hobby and repair projects. Standard 60/40 formula. 4.0 oz. #64-004. . . . . **3.79**

For 73 years, America's source for hobby and repair electronics

Since 1921 Radio Shack has been the place to obtain quality electronic parts, tools, test equipment and accessories. Today we continue our tradition of supplying high-tech products at competitive prices. And we're not *just* for hobbyists! Quantity buyers and purchasing agents: Call or visit your neighborhood Radio Shack store and check out our quantity discount schedule. Save big on wire and cable, test equipment, tools, solder, hardware, chemicals and more. You'll be glad you did!

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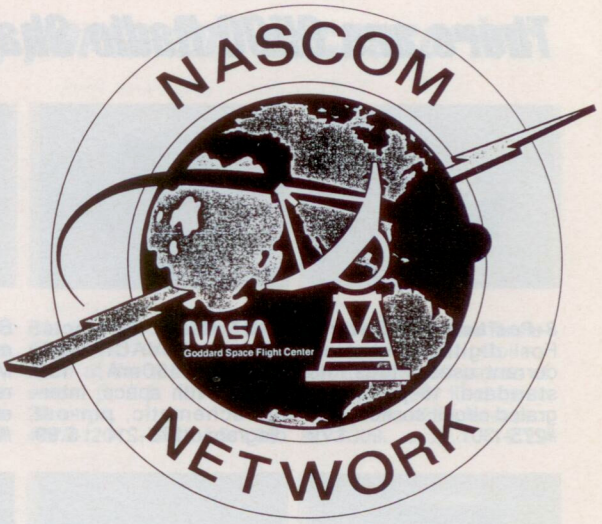
NASA Communications—The Inside Story

Here's your guide to NASCOM, complete with the latest frequencies.

By Mark Chandler



Since the early days of space flight, the ability to communicate with spacecraft and launch vehicles has been essential to placing a satellite into orbit. In 1957, the Naval Research Laboratory (NRL) placed into orbit and tracked the first U.S. spacecraft, Vanguard. The NRL established a network of tracking stations around the world to maintain contact with the satellite, with the Vanguard ground control center located at NRL in Washington, D.C.

Two years later, the newly-formed National Aeronautics and Space Administration (NASA) took control of the ground station network. It moved the control center to the Goddard Spaceflight Center in Greenbelt, Maryland, the current home of NASA Communications (NASCOM).

The NASA Communications Network consists of three tracking and two communications networks. The tracking network consists of the Space Tracking and Data Acquisition Network, which is used in support of unmanned scientific missions in close-to-earth orbits. The Deep Space Network (DSN) supports unmanned missions to the moon and beyond, as well as the Manned Space Flight Network for manned missions The two unmanned networks have been combined to form the Spaceflight Tracking & Data Network.

NASCOM Centers

Goddard Space Flight Center is NASCOM's primary control and switching center. Other centers are located at Canberra, Australia; Madrid, Spain; Cape Canaveral, Florida; Pasadena, California; Huntsville, Alabama; and the Western Space & Missile Center at Vandenberg Air Force Base in California. Through these facilities, over 875 satellite and terrestrial communication circuits link over 140 communication terminals worldwide in support of manned, unmanned, and scientific missions. Madrid is a major switching center and provides interface with the Deep Space Network, the European Space Agency, and the San Marco launch facility in East Africa.

The Canberra Switching facility provides long-haul trunk circuits between the U.S. and Australia from their Deep Space Communications complex in Tidbinbilla.

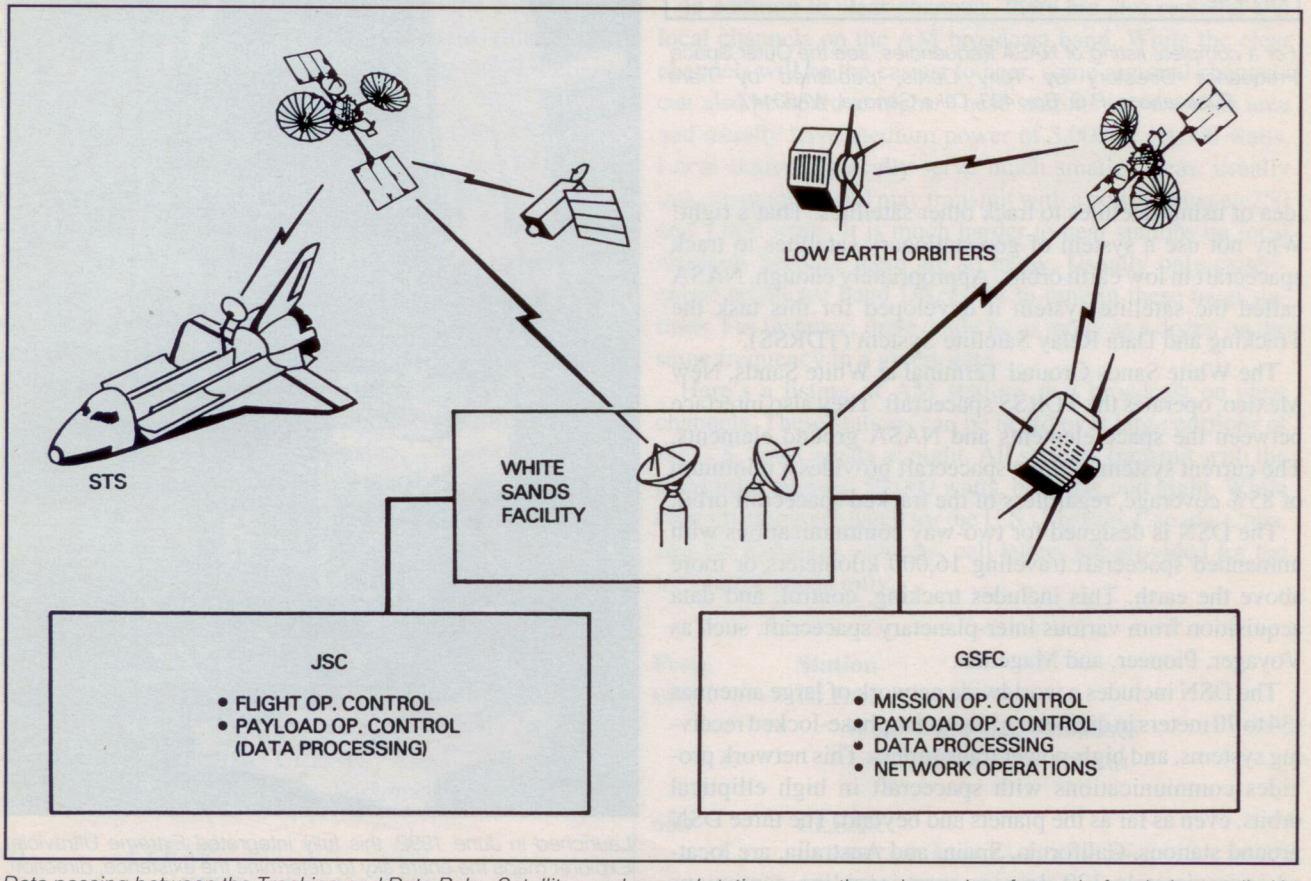
The Jet Propulsion Laboratory (JPL) in Pasadena, California, supports both the Deep Space Network and NASCOM missions. The ground facility at Goldstone, California, provides the 26-meter support for JPL. The Madrid and Canberra facilities also support JPL missions. These three facilities can also provide back-up support for the Tracking and Data Relay Satellite System (TDRSS).

Cape Canaveral Communications Center provides NASCOM with interfaces to all NASA facilities and tracking centers. This joint NASA/DoD (Department of Defense) switching center provides the voice and data channels for launch and spacecraft check-out procedures.

Tracking and Data Relay Satellite System (TDRSS)

In the early days, ground stations such as these used movable antennas that had to be physically pointed at the spacecraft during its overflight. Even with several ground stations located along the expected flight path, communications could only be maintained during a small portion of the spacecraft's orbit. To improve tracking and data acquisition, a new system of tracking was needed. Someone came up with the

Goddard's Network Control Center. Here controllers at the Goddard Space Flight Center Network Control Center work at consoles, keeping "watch" on activities aboard the space shuttle and a number of unmanned satellites. (Photo courtesy NASA.)



Data passing between the Tracking and Data Relay Satellites and ground stations goes through a series of steps before being studied by engineers and scientists.

NASA Frequency Sampler

NASA Kennedy HF (MHz)
3.385
4.376
4.055
5.187
6.937
7.675
10.780
12.160
14.615
20.198

VHF
117.8
148.25
148.455
148.500
167.00
163.460
173.662
335.800 (UHF)

Johnson VHF
164.050
164.985
169.600
171.150

Marshall VHF/UHF
168.450
170.200
171.00
173.285
314.60
382.600

Goddard VHF
147.450
164.175
167.925
170.025
170.400
171.150
173.685

Edwards HF/VHF/UHF
5.597
10.010
17.966
121.80
141.30
149.925
162.610

Ames Dryden VHF/UHF
122.850
139.80
148.550
170.450
173.450
318.400
348.70
272.200

Shuttle Direct
259.700
279.000
296.800

For a complete listing of NASA frequencies, see the Outer Space Frequency Directory *by Tony Curtis, published by Tiare Publications, P.O. Box 493, Lake Geneva, WI 53147.*

NASA Amateur Radio Frequencies (MHz)

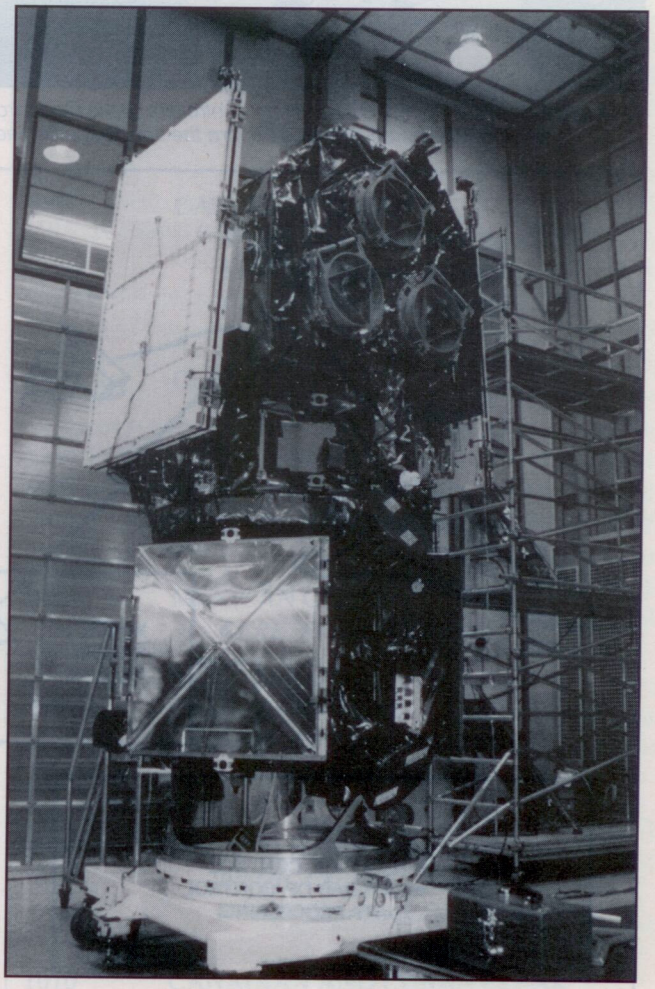
Freq.	Call sign	Facility	Location
3.840	W6VIO	JPL	Pasadena, CA
3.840	K6MF	Ames	California
3.850	W5RRR	Johnson	Texas
3.860	WA3NAN	Goddard	Greenbelt, MD
7.165	K6MF	Ames	California
7.165	W6VIO	JPL	Pasadena, CA
7.185	WA3NAN	Goddard	Greenbelt, MD
7.227	W5RRR	Johnson	Texas
14.270	W6VIO	JPL	Pasadena, CA
14.280	W5RRR	Johnson	Texas
14.295	WA3NAN	Goddard	Greenbelt, MD
21.280	W6VIO	JPL	California
21.340	W6VIO	JPL	California
21.350	W5RRR	Johnson	Texas
21.295	WA3NAN	Goddard	Greenbelt, MD
28.495	W5RRR	Johnson	Texas
28.650	WA3NAN	Goddard	Greenbelt, MD
145.450	WA3NAN	Goddard	Greenbelt, MD

idea of using satellites to track other satellites. That's right! Why not use a system of geo-stationary satellites to track spacecraft in low earth orbits. Appropriately enough, NASA called the satellite system it developed for this task the Tracking and Data Relay Satellite System (TDRSS).

The White Sands Ground Terminal at White Sands, New Mexico, operates the TDRSS spacecraft. They also interface between the space elements and NASA ground elements. The current system of three spacecraft provides a minimum of 85% coverage, regardless of the tracked spacecraft orbit.

The DSN is designed for two-way communications with unmanned spacecraft traveling 16,000 kilometers or more above the earth. This includes tracking, control, and data acquisition from various inter-planetary spacecraft, such as Voyager, Pioneer, and Magellan.

The DSN includes a worldwide network of large antennas (34 to 70 meters in diameter), low-noise phase-locked receiving systems, and high-power transmitters. This network provides communications with spacecraft in high elliptical orbits, even as far as the planets and beyond. The three DSN ground stations, California, Spain, and Australia, are located approximately 120 degrees apart, enabling continuous radio contact with the spacecraft. This means any spacecraft



Launched in June 1992, this fully integrated Extreme Ultraviolet Explorer maps the entire sky to determine the existence, direction, brightness, and temperature of objects that are sources of extreme ultraviolet radiation. (Photo courtesy NASA.)

on a deep space flight is within the field of view of at least one DSN ground station at all times and will be seen by two ground stations for several hours each day.

NASCOM supports DSN by providing dedicated circuits from each DSN complex to the nearest NASCOM switching facility. It's the Mission Operations Integration Specialist who provides specific communications circuits during NASA missions. He is responsible for operational control of all network resources during a specific event. Voice conference is established through Goddard's digitally-controlled two- and four-wire voice circuits. They can establish over 2,000 circuits, 1,990 four-wire private lines, and 300 simultaneous multi-line conference circuits. Two master control panels are run in parallel so two operators can route messages as needed. The consoles are pushbutton-operated for quick circuit switching in real time.

NASCOM voice control is responsible for providing and configuring domestic and international circuits. These are often leased circuits that must provide a bandwidth of 3 kHz. They are capable of transmitting voice and data as needed.

The NASCOM Message Switching System can automatically switch formatted 4,800-bit block messages. This computer system was designed, implemented, and programmed by NASCOM. Two identical systems are on-line to provide redundancy in the event of an equipment failure.

The network is able to deliver data at various operating speeds, from low-speed teletype at 75 baud to a maximum rate of 50 Mb/sec. (million bits per second). To give you some idea what this means, let's put it another way. It's like transmitting the equivalent of a 20 volume encyclopedia with 1,200 pages in each volume and 2,000 words on each page, each second. Time-Division Multiplexing (TDM) techniques are used in this data network.

NASCOM also operates a Teletype Message Section, which is responsible for message preparation, reproduction, and distribution. This section's responsibilities include routine, urgent, and classified messages. Cryptographic services for processing classified messages are trafficked between NASA and DoD in support of DoD missions.

The technical personnel who work for NASCOM usually come from the military or government communications service where they gained knowledge and experience on analog/digital conversion, circuit specifications, fault isolation, various communication formats, fiber optics, and satellite and microwave equipment.

The Future

The future development of the network will depend upon the proposed U.S. space station, the deployment of the advanced second generation TDRSS, and the development of new technology. The NASA "Space Network" will be developed around the space station requirements, international requirements for joint missions (with Russia, the European Space Agency, etc.), and deep space exploration. With so much ahead, scanning NASCOM will prove to be even more exciting. ■

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Shortwave Lingo—It's Easier To Understand Than You May Think

Our radio hobby uses more abbreviations than the Army, but ours is easier to understand. Let's take a look.

By Gerry L. Dexter

"11710 - RAE, 0200 s/on, EE to NA, w w/ID, sked. Into nx, ID, tlk by M, comtry. Co-chan QRM, some QSB. Into SS at 0300."

The fresh-faced shortwave listener may certainly be forgiven for confusion after reading the above listener report. It's a hypothetical, yet typical, example of a listener report you'd find in a radio magazine or shortwave club newsletter. But, if you're uninitiated, it's almost enough to make you reach for the Bayer bottle!

So What's with the Funny Terms?

The radio hobby, like any other activity, has its own set of abbreviations and esoteric terms. This list has grown substantially over the last 70 years as the types and modes of transmission expanded, along with the radio spectrum itself. Every change brought more terms and abbreviations. Abbreviations were particularly useful in the early days of radio communication when transmissions were mostly via Morse code. They cut down on the number of letters which had to be sent and thus reduced the time it took to send a message. A good number of these have been carried over into non-Morse use and are still popular in written and spoken form throughout the radio hobby.

Are You Ready for Some "SWL-ese"?

There are dozens of aspects to the radio hobby (both transmitting and receiving) and each has its own particular set of terms and abbreviations. A list of all the terms and abbreviations covering everything from monitoring beacons on longwave to receiving transmissions from Ku-band satellites would certainly fill much or all of this magazine!

Of necessity, then, the list that follows must be somewhat smaller. We've tried to list those abbreviations you, as a shortwave listener, are most likely to run across in magazines and club bulletins—in the hopes you won't have to reach for those headache tablets quite so often. Remember that there's often no consistency in the use of upper and lower case. You're as likely to run across "w" as you are to find "W."

Broadcaster names are frequently abbreviated. We've included several of the main ones, but left out some smaller ones, such as "RB" for Radio Bulgaria, as well as the less frequently heard stations.

So here's your starter's guide to figuring out what the heck all those SWLers are talking and writing about!

Typical SWL Abbreviations and Symbols

*	indicates a sign on or sign off time
/ /	parallel; two or more frequencies carrying same program
A	approximate
AA	Arabic (also AR)
ABC	Australian Broadcasting Corporation
addr	address
AF	Africa
AGC	automatic gain control
AIR	All India Radio
alt	alternate (frequency)
AM	amplitude modulation; also AM radio
ANARC	Association of North American Radio Clubs
anmt(s)	announcement(s)
ann	announcement; announcer
anncr	announcer
ant	antenna
approx	approximate
Apt.	apartado (post office box)
ARRL	American Radio Relay League (national ham radio organization)
AWR	Adventist World Radio
BBC	British Broadcasting Corporation
BBCM	BBC Monitoring Service
BC	broadcast
bcst	broadcast
bcstng	broadcasting
BFO	beat frequency oscillator
BSKSA	Broadcasting Service of the Kingdom of Saudi Arabia
C.P.	Caixa Postal (post office box)
CA	Central America
canned	pre-recorded
carrier	the radio wave upon which modulated information is sent
CC	Chinese (also CH)

cd	card
CE	chief engineer
chex	checks
cmtry	commentary
co-chan	interference from a station on same frequency
CQ	general call
CRI	China Radio International
CUL	see you later
cult	cultural; cultura
CW	Morse Code
d	daily; directional
db	decibel
de	from
Dir.	director
DS	domestic service
duplex	two stations in contact using different frequencies
DW	Deutsche Welle (The Voice of Germany)
DX	distance (long distance reception)
DXer	one who pursues DX
DXing	the activity of pursuing DX
ECNA	East coast of North America
ECSS	listening to an AM signal using the receivers BFO
EE	English (also EG)
ERP	effective radiated power
EU	Europe
EZL	easy listening (music)
f/d	full data verification
f/in	fade in
f/out	fade out
f/up	follow-up report
FAX	facsimile transmissions via radio
FB	fine business (very good)
FCC	Federal Communications Commission
FE	Far East
FF	French (also FR)
fqy	frequency
freq	frequency
frm	from
gd	good
GG	German (also GM)
GMT	earlier term for what is now called UTC
het	heterodyne interference
HF	high frequency; the shortwave frequency range
Hi	meant to convey humor or indicate a humorous remark
hr(s)	hour, hours
hrd	heard
HS	home service
ID	station identification
IRC	international reply coupon (used as return postage)
irr.	irregular operation
IS	interval signal
ITU	International Telecommunications Union
kHz	kiloHertz
KW	kilowatt(s)
L	(after a frequency) indicates transmission in LSB
LA	Latin America(n)
lang.	language
lcl	local
LSB	lower sideband
ltr	letter
LUF	lowest useable frequency
LV	La Voz; La Voix (the voice of)
LW	long wave, the area below the AM broadcast band
m	man
m	(after a number) meters, as 49m - 49 meters
MARS	Military Affiliate Radio Station
mb	meter band
ME	Mid-East; Middle East
MHz	MegaHertz
mode	type of transmission; AM, FM, CW, RTTY, etc.
MT	Monitoring Times magazine
MUF	maximum useable frequency
MW	medium wave, generally the AM broadcasting band
mx	music
n/d	no data verification
NA	North America, national anthem
nd	non-directional antenna
net	network
nom.	nominal frequency
nx	news
OM	old man (any man)
p	(after frequency) - presumed to be station in question
p	poor
p/d	partial data verification
pattern	the direction(s) an antenna beams a signal
PopComm	Popular Communications magazine
PP	Portuguese (also PT)
prop	propagation
pse	please
PWBR	Passport to World Band Radio
px	program(s)
QRM	interference from another station
QRN	interference from static
QRP	low power
QRT	off the air
QSB	fading
QSL	a verification of reception received from a station
QTH	location
r	reported
R.	Radio (station name)
RAE	Radiodifusion Argentina al Exterior
RAI	Radiotelevisione Italiana
rcvr	receiver
Rdf	Radiodiffusion
rec	record, recorded, recording
REE	Radio Espana Exterior
RF	radio frequency
RFE/RL	Radio Free Europe/Radio Liberty
RFI	radio frequency interference
RFI	Radio France International
rig	your radio equipment
RIT	receiver incremental tuning - a fine tuning control
RNZ	Radio New Zealand
Rp	return postage
rpt	report
rptd	reported
RR	Russian (also RU)
RRI	Radio Republik Indonesia
RST	signal reporting method used by amateur radio operators
RTTY	radio teletype
rx	receiver
s/off	sign off

The Shortwave Bands Close-Up

Frequency Range (MHz)	Meter Band
2.3– 2.495	120
3.2–3.4	90
3.9–4.0	75
4.75– 5.06	60
5.9–6.2	49
7.1–7.35	41
9.4–9.9	31
11.6–12.1	25
13.57–13.87	22
15.1–15.8	19
17.48–17.9	16
18.9–19.02	15
21.45–21.75	13
25.6–26.1	11

Amateur Radio Bands

Frequency Range (MHz)	Meter Band
1.8–2.0	160
3.5–4.0	80
7.0–7.3	40
10.1–10.15	30
14.0–14.35	20
18.068–18.168	17
21.0–21.450	15
24.890–24.990	12
28.0–29.7	10

Note: Frequencies outside of the bands assigned to the broadcasting and amateur radio (and sometimes within them) are used by a wide variety of stations: fixed communications stations, maritime and aeronautical, U.S. and foreign military communications, U.S. and foreign government, standard time, so-called "spy" broadcasts, VOLMET aviation weather reports, shortwave broadcast feeder stations, unlicensed "pirate" broadcasters and more. Transmissions may be in voice (AM or single-sideband), Morse code, various forms of radioteletype, or facsimile or more esoteric forms of modulation.

s/on	sign on
SA	South America
SASE	self addressed, stamped envelope
sfx	sound effects
shack	your radio room
sig(s)	signal, signals
simplex	two stations in contact using same frequency
SINPO	a means of reporting on the quality of received signal
SIO	a means of reporting on the quality of received signal
sked	schedule
SRI	Swiss Radio International
SS	Spanish (also SP)
SSB	single sideband
STL	studio-transmitter link
stn	station
SW	shortwave, generally the area between 1.7 and 30 megahertz
SWL	shortwave listener
T	(after a frequency) - tentative reception
t/in	tune in
t/out	tune out
TC	time check
tech	technical
tent	tentative
tfc	traffic (messages)
tlk	talk, talking
tnx	thanks
TVI	television interference
TWR	Trans World Radio
TX	transmitter
U	(after a frequency) indicates transmission in USB
UHF	ultra high frequency (300 MegaHertz and up)
unid	unidentified station
unk	unknown
USB	upper sideband
UTC	Co-ordinated Universal Time
V	frequency varies
vcl(s)	vocal, vocals
vern	vernacular (a local language)
vfd	verified
VG	very good
VHF	very high frequency (30 - 300 Megahertz)
VOA	Voice of America
VOFC	Voice of Free China
VOIRI	Voice of the Islamic Republic of Iran
VOLMET	stations broadcasting continuous aviation weather
vy	very
w	watt(s)
w	woman
w/	with
WCNA	West coast of North America
whip	a pull-up antenna, usually attached to a portable radio
work	to communicate with another station
wpm	words per minute
WRTH	World Radio TV Handbook
WS	world service
wx	weather
xmtr	transmitter
XYL	married woman
YL	young lady, any unmarried female
73	best regards
88	love and kisses

Best Bet Shortwave Broadcasts In English

For most people, tuning in foreign broadcasts is the biggest lure of shortwave listening. To get you started on the international shortwave listening scene, we've provided a listing of some of your "Best Bets." These are stations that you're likely to be able to pick up and that broadcast at least some of the time in English.

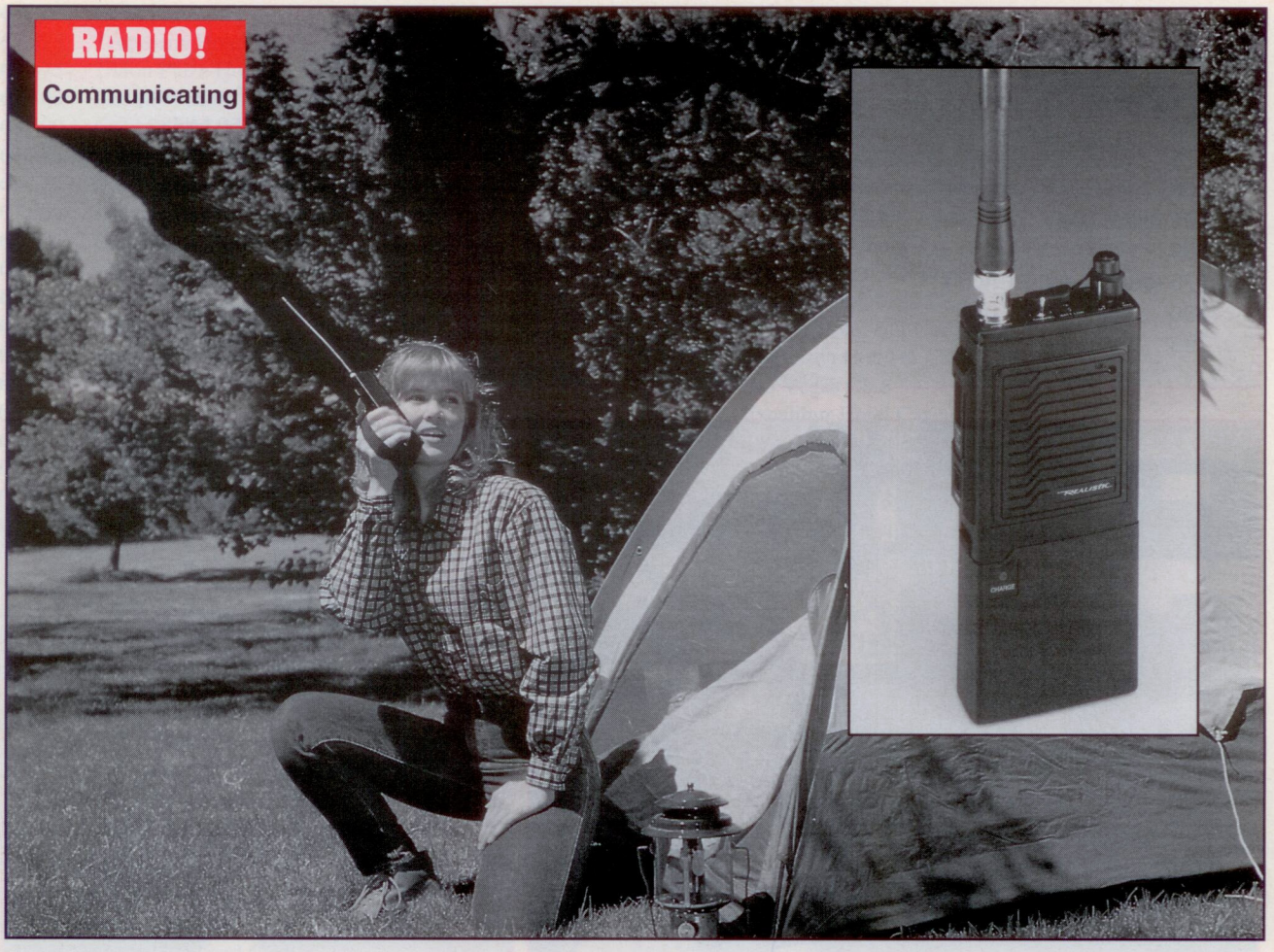
How well you receive the stations listed here will vary with atmospheric conditions, seasonal changes, your listening location, and your receiving equipment. Stations may make changes in the times and frequencies of broadcasts with little or no advance warning. Some will move their transmissions up or back an hour with the arrival or departure of their local daylight savings time. Not all of the frequencies listed for a particular broadcast will provide equally good reception; some frequencies may not even be in use. Stations may also have other frequencies in use at the times listed here. Many stations are also on the air at other times and on other frequencies. Some broadcasts are on weekdays only, or are not on the air daily. A complete listing of all shortwave English language broadcasts would occupy several pages, so this list should therefore be viewed just as a starting point. Stations will often announce their other times and frequencies.

We have provided a general grading to give you some idea of what kind of reception you may expect from each station. The grading is based on the use of an average portable shortwave receiver under normal propagation conditions. One star indicates generally poor reception, two is average, three indicates generally good reception. Listeners in the western part of the U.S. will generally get better reception from Asia and the Pacific than will listeners in the east. Conversely, those in the east will enjoy better reception from stations in Europe and Africa.

Times indicated are UTC (Coordinated Universal Time). This 24-hour universal time system is five hours ahead of Eastern Standard Time, so 0000 UTC equals 7 p.m. EST, 6 p.m. CST, 5 p.m. MST and 4 p.m. PST. All broadcasts listed here are in English and, on the average, represent the time and frequency combinations which should provide best reception.

Station	Time	Frequencies	Grade
R. Tirana, Albania	0130	9580, 11840	**
R. Algeria	1600	11715, 17745	*
RAE, Argentina	0200	11710	**
R. Australia	1200	9580, 11660, 11800	***
R. Austria	0530	6015	***
R. Vlaanderen, Belgium	0030	6035, 9930	*
Radiobras, Brazil	1200	15445	*
R. Bulgaria	0000	7205, 9700	**
R. Canada Int'l	0100	6120, 9755	***
CFRB/CFRX, Canada	24 hrs.	6070	**
China Radio Int'l	0000	9710, 11715	**
AWR, Costa Rica	0000	5030, 6150, 9725, 11870	**
Croatian Radio	0300	5895	***
R. Havana, Cuba	0000	6010, 13700	***
R. Prague, Czech Rep.	0100	7345	**
HCJB, Ecuador	0030	9745, 11925	***
R. Cairo, Egypt	0200	9475	*
BBC, England	24 hrs.	5975, 7325, 9410, 9590, 15220, 15260	**

Station	Time	Frequencies	Grade
R. Finland	1230	11735, 15400, 17740	**
R. France	1200, 1400, 1600	9805, 11615, 13640	**
Deutsche Welle, Germany	0100, 0200, 0300	6040, 6145, 9565	***
V. of Greece	0130, 0340	9420, 9935	*
R. Cultural, Guatemala	0300	3300	*
NBC, Papua New Guinea	1100	4890	**
R. Budapest, Hungary	0330	5965, 7220, 9835	*
All India Radio	1900	11620	*
VOIRI, Iran	0030	7100,9022,11790	**
Rep. of Iraq Radio	1030	13680	*
Kol Israel	0500	7465, 9435	**
RAI, Italy	0050	9725, 11800	**
R. Japan	0300, 1100	5960, 6120	***
R. Jordan	1200	9560	*
R. Kuwait	1800	11990	**
ELWA, Liberia	0600	4760	*
V of Mediterranean, Malta	0600	9765	*
R. Netherlands	0030	6020, 6165, 9840	***
R. New Zealand	0600	9700	**
V. of Nigeria	0500	7255	*
R. Pyongyang, N. Korea	1100	9977, 11335	*
R. Norway	1200 (Sun)	11850	**
R. Pakistan	1600	15555, 17660	*
Polish Radio Warsaw	1300	7270, 9525, 11815	*
R. Portugal	0230	9570, 9705, 11840	**
R. Romania	0200	6155, 9510	*
R. Moscow	1200-0700	5915, 7165, 9920, 11675, 13370, 15495	**
R. Singapore	1100	9530	*
Slovak R., Slovakia	0100	5930, 7310, 9440	*
Channel Africa, S. Africa	0300	5955, 9585, 11900	*
R. Korea, S. Korea	1030	9650, 11715	*
Spanish National Radio	0000	9540	**
R. Sweden	0330	6200, 9850	**
Swiss Radio Int'l	0100	6135, 9885, 9905	**
R. Damascus, Syria	2005	12085, 15095	*
V. of Free China, Taiwan	0200	5950, 9680	***
R. Thailand	0030	11905	*
V. of Turkey	2300, 0400	9445	*
R. Ukraine	0100	7180, 9620, 9810	**
UAE Radio, Abu Dhabi	2200	9605, 9770, 11885	**
Voice of America	24 hrs.	5995, 9760, 13710, 15205, 15580	***
R. Tashkent, Uzbekistan	1200	9715, 13785	*
Vatican Radio	0250	6095, 7305	**
R. Nacional, Venezuela	0040	9540	**
R. Yugoslavia	0000	9580, 11870	**



Quiet GMRS Split Channels

The inexpensive, fun way to stay in touch.

By Gordon West, WB6NOA

Imagine the communications possibilities of being able to talk through repeater relay systems over hundreds of square miles—without having to pass a license test! Well, that's what the General Mobile Radio Service (GMRS) opens up for you. All you need is a license that's obtained by simply submitting FCC form 574. Here are the details.

The GMRS is a land mobile radio service available to licensees and their immediate families for short distance two-way communications. The GMRS band is located at 462 MHz, a tightly controlled spectrum of radio frequencies also used by police, fire, government, and military agencies.

Every service has its own allocation of channels, and the personal, non-business GMRS band has been assigned eight frequency pairs exclusively for its use (see Table 1). The FCC regularly polices these frequencies to ensure only legitimately licensed operators use them.

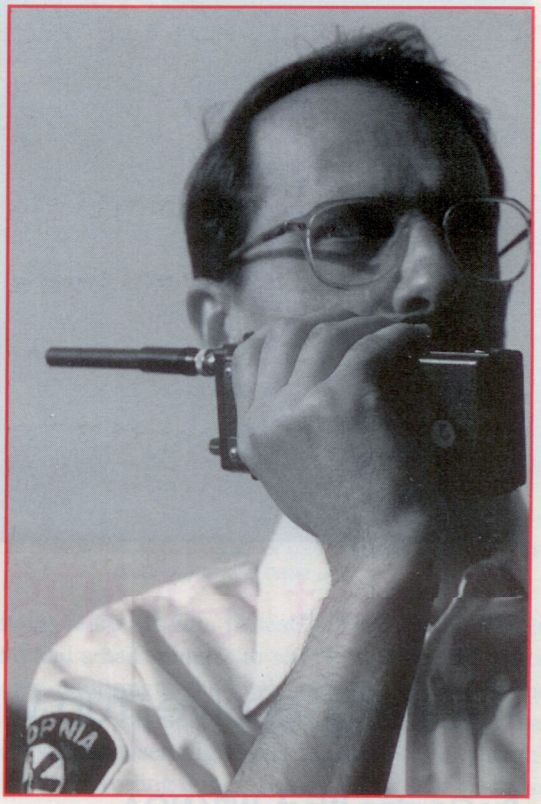
There is plenty of activity on these channels. Mobile units and base stations can run up to 50 watts of output power on these channels, and powerful base station repeaters will pump out GMRS signals for up to 80 miles. Mobile units and repeater stations are assigned a specific channel out of these eight channels, and mobile units transmit 5 MHz higher than they receive on the base station. Mobile units may also transmit on "simplex" as they operate "talk-around" on a base station frequency. Simplex mobile-to-mobile and mobile-to-handheld communication is currently only allowed on the 462-MHz channels to prevent accidental triggering of another licensee's repeater station.

Handheld-to-handheld GMRS operation between family members has been a low-cost, practical way to stay in touch out in the wilderness or in rural areas of the U.S. But as soon as you get near any major city, the eight GMRS channels are

Table 1

Designator	Base & Mobile Frequency	Mobile Frequency
550	462.550 MHz	467.550 MHz
575	462.575 MHz	467.575 MHz
600	462.600 MHz	467.600 MHz
625 (black dot)	462.625 MHz	467.625 MHz
650	462.650 MHz	467.650 MHz
675 (orange dot, REACT)	462.675 MHz	467.675 MHz
700	462.700 MHz	467.700 MHz
725	462.725 MHz	467.725 MHz

The GMRS service is for families who need to stay in touch with each other using low-cost UHF radios. (Photo by Ron Earl.)



A volunteer rescue squad member (at right) uses GMRS to reach "REACT" on "675" frequencies. (Photo by Gordon West.)

usually bustling with repeater activity, and these powerful signals can drown out all but close-in communications between handhelds. So, what works great "out in the sticks" doesn't work very well in major cities where personal communications between handhelds is desired.

The FCC, acknowledging that handheld-to-handheld personal communications were indeed desirable for today's portable society, worked closely with the Personal Radio Steering Group (PRSG). This all-volunteer, not-for-profit corporation was created in 1980 by GMRS licensees to provide services to and advocate for the GMRS personal-use community. Working together to develop a frequency channel plan for low-power handheld GMRS transceivers to intercommunicate in downtown city areas, the FCC created an interstitial frequency plan. Specifically for low-power mobile and handheld units, these frequencies are in between the regular high-power GMRS channels (see Table 2).

Using frequencies that are sandwiched in between other frequencies has been a long-standing solution for more channel pairs in many of the other radio services, too. Now that surface-mount technology (SMT) has miniaturized the number of components on a printed circuit board, additional filters can be placed on that board to "zero in" on the desired channel, with enough selectivity to filter out the other channels on either side.

But not all GMRS handhelds and mobile units have interstitial channel capabilities. Many sets operate "simplex" on one of the eight-channel base and repeater output frequencies, and, in downtown areas, communications are all but impossible between handheld or mobile units separated by more than a half mile. On interstitial frequencies, however, in-city range for a pair of handhelds could be as great as 5 miles, mobile-to-mobile handheld range up to 15 miles, and on interstitial frequencies out in the wilderness, mountain-

Table 2

Designator	Frequency
5625	462.5625 MHz
5875	462.5875 MHz
6125	462.6125 MHz
6375 (Radio Shack)	462.6375 MHz
6625	462.6625 MHz
6875	462.6875 MHz
7125 (Radio Shack)	462.7125 MHz

top-to-valley communications with a pair of low-power handhelds might exceed 30 miles.

The way to tell whether or not a UHF GMRS handheld is on an interstitial frequency is to count the number of digits after the decimal point (four numbers after the decimal point indicates quiet channels in between regular base and mobile channels.) The Radio Shack PRS-100 two-channel radio, for instance, operates on 462.7125 and 462.6375 MHz interstitial frequencies. Power output on these interstitial frequencies is limited to no more than 5 watts effective radiated power.

License Required

Obtaining the simple FCC GMRS license with call letters is still a requirement for all GMRS frequencies. FCC Form 574, plus instructions, is available with most GMRS equipment. You would apply for any one of the eight standard duplex channels—your choice—and would also apply for GMRS channel 462.675/467.675 if you plan to use additional mobile radios for traveler assistance or in emergencies. The Commission normally will assign only two regular GMRS channels. Part of that two-channel grant is blanket authorization to use any mobile or handheld transceiver, with less than 5 watts of effective radiated power, on any one of the quiet seven interstitial frequencies. You get all seven, in addition to one or two regular high-power channels.

Even though you might not plan to ever use any one of the high-power duplex/repeater channels, simply follow the instructions that accompany your handheld transceiver. Fill out FCC Form 574 to obtain call letters, and as soon as your call sign hits your mailbox, you can begin personal operation on any one of the seven interstitial frequencies. Chances are you and your family won't be hearing anyone else on these "quiet" frequencies, but you should still use your assigned FCC call letters even though there may not be anyone else listening in the area.

So, if you're looking for an inexpensive way to stay in touch with family members on your next fishing trip or while on a downtown shopping spree, buy a pair of the GMRS UHF/FM handhelds. Then you can quietly go on the air on any one of those seven frequencies, just as soon as your FCC call sign comes back from Gettysburg, Pennsylvania. ■

Hams, SWLs, scanners and CBers agree:

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You've got questions. We've got answers.℠

CB's Best Kept Secret

Information is there when you need it, just for the listening.

By Ron McCracken

Too many CB operators are missing some of the very best CB has to offer them. Are you among their number? Do you realize that there are bonus payoffs to using your CB radio? When did you last just sit back and listen to your CB? That's right, just listen?

Hand someone an AM/FM broadcast radio of whatever type and they get hour after hour of enjoyment from listening to it. Give the same individual a CB radio and all too likely he'll pounce at once on the mic button—even if he has nothing to say.

Well, a CB is for talking, isn't it? Sure, but it's also a great listening tool. Let's consider its listening value.

A Bonanza

Channel 19, the well-known "truckers' channel," is a prime example. It's a treasure trove of helpful information for those who are content to just listen.

Truckers, in case you didn't know, consider Channel 19 "theirs." They generally don't appreciate contacts from "four-wheelers," as they refer to the rest of us mere road users.

You can understand that when you recall that they're busy jockeying 40 or 50 tons of vehicle and cargo on rain-slicked or icy roads during heavy rush-hour or holiday traffic. Despite their seeming anti-social attitude, truckers will gladly provide you with a wealth of priceless tips. You can have them all, just by listening.

My Personal Experience

I'm indebted to truckers for saving me many hours of driving time, maybe even a pile-up or two. I never talked to them. I just eavesdropped on their communications as they gave each other valuable driving tips.

On one recent trip to Florida, I sure was thankful to truckers and my CB radio. They saved me about eight hours in holiday traffic jams, and tipped me off to a pile-up I could easily have joined. On other trips I've had similar, but less dramatic, experiences. Take for instance when I heard the truckers warning of a 25-mile backup in a construction zone. I hastily pulled off the road for the night. Early the next morning I rolled through the construction zone at the posted speed limit with no delay. Another four hours saved, not to mention the frustration.

You, too, can benefit just as easily. When you head out on a trip, bring the CB, tune it to Channel 19. Turn the volume down to escape the chatter or occasional strong language. Your ear will quickly learn to pick up any urgent messages, then you can turn up the volume.

When and Where to Listen

Pay particular attention to Channel 19 as you approach large cities along your route. Many have bypasses, but they add miles to your journey. Listen to the truckers' tips to one another about best routes. Often the business route may be fine, even better than a bypass under construction.

On that same Florida trip, I saved four hours by taking the long Cincinnati bypass that truckers advised using. The I-75 bridge was under construction and holiday traffic was backed up for miles. Later on, a jet-fast car swept by me as I listened to truckers warn of a collision several miles ahead. I slowed and moved to the right lane which they said was open. Sure enough, when I reached the scene there was now a second collision. The speeding car had a crumpled front end and anti-freeze was flowing from a broken radiator. A nice vacation ruined. Whew!

Another key time to listen is when you see a weather front approaching. Truckers will be sharing weather reports that

can save you headaches, and heartaches, too. Your CB and their tips can help you prepare for rain, sudden heavy fogs, etc. That few minutes of advance notice your CB brings can literally be a lifesaver.

As you near construction zones perk up your CB ears. Tips from drivers about hazards, back-ups, collisions, lane closures, etc., are invaluable. Again, they can help you avoid a serious mishap.

Channel 19 listening on a trip is some of the most useful listening you can ever do. Once you've tried it you will quickly realize its value. And, you won't have all the truckers mad at you for bugging them with questions they simply don't have time to answer.

Other Channels, too

Depending on what you like, other CB channels can be fun and worthwhile to monitor. Channel 13, for example, is heavily used by RV owners and boaters. Locally, you may find commuters relying on Channel 10 or another favorite channel for sharing traffic conditions, etc. You will need to work your way around the dial to determine which channels offer the best listening in your particular area. A check with other CB operators you know can speed the process.

Emergencies

Channel 9 listening can be a real education. It can also make you a hero in a split second.

Listening to emergency Channel 9 will quickly alert you to the frequent difficulties police, REACT members, and others face trying to help people on CB. Few callers, you will find, know how to correctly declare an emergency. They fail to air essential information responders need. It's crucial to broadcast your CLIP (Call sign, Location, Injuries, Problem) as follows:

1) identify yourself, including Call sign

2) provide your Location—be exact and include city, state/province

3) describe Injuries—the number and type, whether anyone is trapped

4) describe Problem—give details and explain the help needed.

Repeat the message over several times, even if you don't hear a reply. This increases your chances of being heard by somebody, somewhere!

Happy endings do happen on Channel 9, of course. An upstate New York listener recently saved the life of a disabled man. He heard the man gasping for help as his oxygen tank neared empty. He advised the fire and ambulance service which reached the victim in time. Imagine the "rush" that listener got.

Simply listening in on your CB radio can bring you a lot of useful information. It can also bring you a lot of satisfaction and enjoyment.

Now you know CB's best-kept secret. Tell a friend! ■

Citizens Band 10-Codes

To facilitate communications and permit users to understand each other, especially in a noisy environment, a system of abbreviations known as 10-codes has evolved for use by CBers. Here are some of the more common 10-codes and their meanings.

10-1	Receiving poorly
10-2	Receiving well
10-3	Stop transmitting
10-4	ok, message received
10-5	Relay message
10-6	Busy, stand by
10-7	Out of service, leaving the air
10-8	In service, subject to call
10-9	Repeat message
10-10	Transmission completed, standing by
10-11	Talking too rapidly
10-12	Visitors present
10-13	Advise weather/road conditions
10-16	Make pick up at
10-17	Urgent business
10-18	Anything for us?
10-19	Nothing for you, return to base
10-20	My location is
10-21	Call by telephone
10-22	Report in person to
10-23	Stand by
10-24	Completed last assignment
10-25	Can you contact
10-26	Disregard last information
10-27	I am moving to channel
10-28	Identify your station
10-29	Time is up for contact
10-30	Does not conform to FCC rules
10-32	I will give you a radio check
10-33	EMERGENCY TRAFFIC/MESSAGE
10-34	Trouble at this station
10-35	Confidential information
10-36	Correct time is
10-37	Wrecker needed at
10-38	Ambulance needed at
10-39	Your message delivered
10-41	Please turn to channel
10-42	Traffic accident at
10-43	Traffic tie-up at
10-44	I have a message for you
10-45	All units within range please report to
10-50	Break channel
10-60	What is next message number?
10-62	Unable to copy, use phone
10-63	Net directed to
10-64	Net clear
10-65	Awaiting your next message/assignment
10-67	All units comply
10-70	Fire at
10-71	Proceed with transmission in sequence
10-77	Negative contact
10-81	Reserve hotel room for
10-82	Reserve room for
10-84	My telephone number is
10-85	My address is
10-91	Talk closer to mike
10-93	Check my frequency on this channel
10-94	Please give me a long count
10-99	Mission completed, all units secure
10-200	Police needed at

You're On The Air!

It's your big day—your ham license just arrived and you're ready for action. Here are a few tips to get you started.

By John A. Magliacane, KD2BD

So, you've studied hard, passed your exam, and earned your ham license! Now it's time to concentrate on establishing good radio operating practices so you can be an effective communicator and successful radio operator.

In addition to the FCC's rules and regulations, there are certain points of etiquette and tricks of the trade that should be followed when operating on the ham bands. Failure to do so could result in being labeled a "lid" (a poor operator) by more experienced hams. But using proper on-the-air procedures will ensure that your first contact is a successful and rewarding experience.

Amateur radio operators are allowed to communicate with other hams around the world using various forms of voice, data, and image communications. Each mode exists in its own "world," populated by different people with different interests and areas of expertise. As such, the recognized operating procedures particular to each of these modes varies greatly. Let's look at a few of the modes, their accepted procedures, and some of the reasons behind them.

But First, Lend an Ear

No discussion of operating procedures would be complete without some discussion of the importance of developing good listening skills. One of the most important skills a radio operator has is his or her ability to listen. Before you make your first radio contact, spend time tuning across the ham bands listening to the operating procedures used by more experienced hams. You can really get a feel for what works and what doesn't simply by listening to others. The time spent observing and learning like this will go a long way toward making you a successful and effective radio operator.

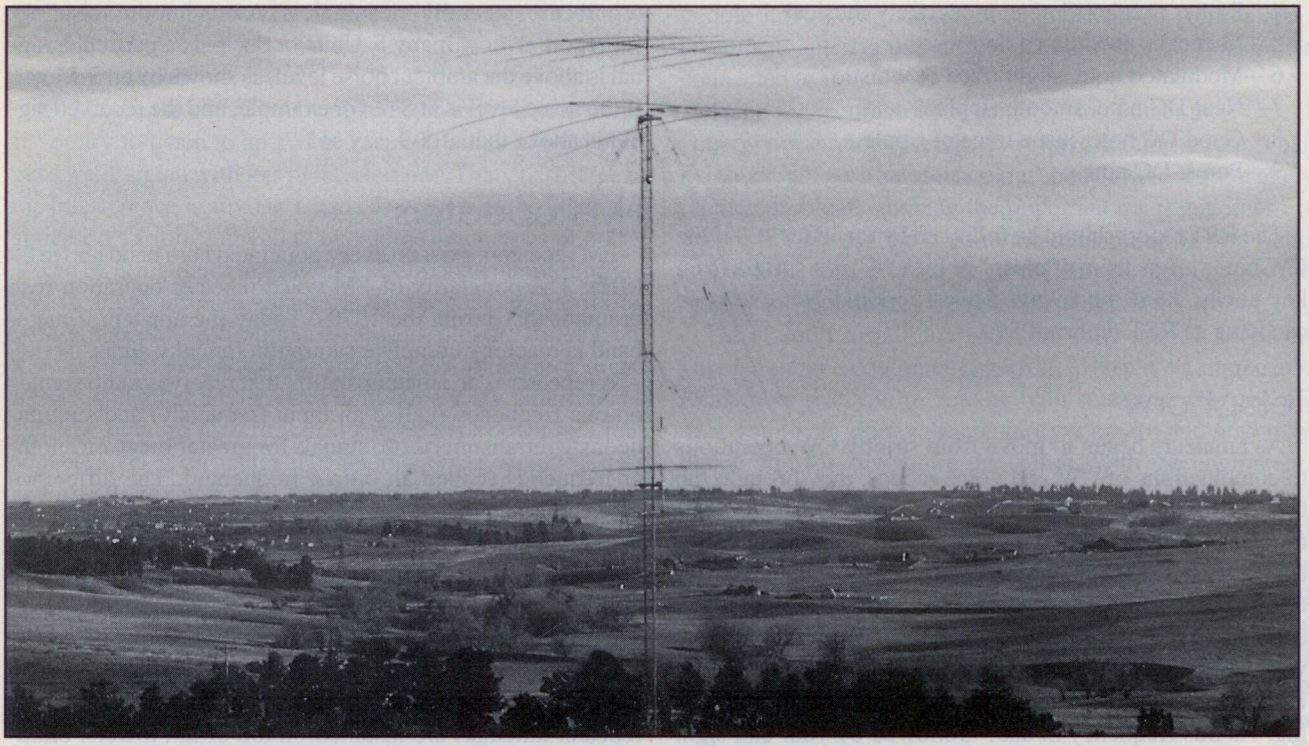
Telegraphy

The earliest form of "wireless" communication was text messages encoded for radio transmission using the Morse code, often referred to as CW. When radio operators wish to make contact with anyone who can hear them, they transmit the Morse characters "CQ" several times followed by their call sign and then listen for a response. CQ has a very distinctive sound and has been used since the very early days of radio. It's used with virtually every form of communications on the amateur bands.

Tune across the ham bands before you make your first radio contact. Regardless of the band you're on or the mode you're using, it pays to listen first, then talk. (Photo by Kenneth Brockel, N2SMT.)

If you wish to make a radio contact with anyone who can hear you, there are a few things that should be considered before calling CQ. First, you should tune your receiver across the band and listen for others who may already be calling CQ. If you don't hear anyone, *you* can call. It's best to search for a clear frequency before calling CQ yourself. Find a clear frequency away from band edges and center your transmit frequency within the opening. Verify the frequency is indeed clear by sending "QRL?" which means "Is this frequency in use?" followed by your call sign, like this:

QRL? DE KD2BD AR



It would be great to have this ham's towering antenna system, but transceivers and antennas are only one part of operating. Perhaps the most important part—proper on-air procedures—will make you a successful and effective radio operator. (Photo by Patrick Griffith.)

If no one responds, then it's safe to call CQ. The following calling procedure works well on CW:

CQ CQ CQ DE KD2BD
CQ CQ CQ DE KD2BD KD2BD
CQ CQ CQ DE KD2BD KD2BD KD2BD AR K

Remember, your call can be answered by anyone, so don't send CQ faster than you can copy a response. Your sending should be clear and well-paced. If your sending is sloppy, you'll find few people will want to answer your call. It's also considered bad operating practice to send CQ more than three times in a row during a single transmission. An endless string of CQs doesn't attract contacts. It turns people away.

After your CQ transmission, listen for anyone who may answer your call. It's a good idea to tune your receiver VFO or transceiver incremental tuning (RIT) control several kHz above and below your transmit frequency after your CQ, just in case someone calls you off your transmit frequency. If you hear someone call you off frequency, you should leave your transmit frequency fixed, unless the other station asks you to move by sending QSY, a request to change.

A person answering a CQ should do so by calling the station and following it with his call sign. For example, if N2JUX answered my CQ, he might send the following:

KD2BD KD2BD KD2BD DE N2JUX N2JUX N2JUX K

Once contact has been made, it's time to carry on a QSO, a two-way radio exchange. Don't forget to identify your station at least once every 10 minutes during your contact and to use the minimum transmitter power necessary. This is not only common courtesy, but also an FCC rule.

Signal reports exchanged during a CW contact should use the RST reporting system. This internationally-recognized system rates the Readability, Strength, and Tone of a sending station as a three digit number. The system is as follows:

Readability
1—Unreadable
2—Barely readable, occasional words distinguishable
3—Readable with considerable difficulty
4—Readable with practically no difficulty
5—Perfectly readable

Strength
1—Faint signals, barely perceptible
2—Very weak signals
3—Weak signals
4—Fair signals
5—Fairly good signals
6—Good signals
7—Moderately strong signals
8—Strong signals
9—Extremely strong signals

Tone
1—Extremely rough hissing sound
2—Very rough AC note, no trace of "musicality"
3—Rough low-pitched AC note, slightly musical

4—Rather rough AC note, moderately musical
5—Musically modulated note
6—Modulated note, slight trace of whistle
7—Near DC note, smooth ripple
8—Good DC note, just a trace of ripple
9—Purest DC note

The RST report should be followed by the letter "C" if the CW note suffers from a "chirp" or by a "K" if it suffers from key clicks. Remember, give honest reports! Not everyone can have an RST report of 599.

Telephony

As amateurs began to move from strictly CW operations to combinations of CW and voice modes, they brought the CW operating procedures to the new radiotelephone communications modes. As with CW, stations operating radiotelephone wishing to establish radio contact with others call CQ. Like CW, the correct practice is to first listen for others calling CQ before calling CQ yourself. If no calls are heard, you should find a clear frequency away from band edges and interference, and verify the frequency is indeed clear by asking, "Is this frequency in use?" followed by your call sign. If it is in fact clear, then you may proceed with a CQ, like this one:

"CQ CQ CQ calling CQ. This is KD2BD, Kilo Delta Two Bravo Delta, Kilo Delta Two Bravo Delta calling CQ and standing by."

The exact format used isn't as important as being brief. You want your call to be long enough for people to hear you, but short enough so you don't put people to sleep waiting for you to finish. Your speech should be clear and distinct. Make use of the phonetic alphabet presented below when giving your call sign. Although a few different phonetic alphabets have been used in radiotelephone communications over the years, this alphabet, developed by the International Civil Aviation Organization, has become the accepted standard for international amateur radio communications.

Phonetic Alphabet

A	Alpha	J	Juliet	S	Sierra
B	Bravo	K	Kilo	T	Tango
C	Charlie	L	Lima	U	Uniform
D	Delta	M	Mike	V	Victor
E	Echo	N	November	W	Whiskey
F	Foxtrot	O	Oscar	X	X-ray
G	Golf	P	Papa	Y	Yankee
H	Hotel	Q	Quebec	Z	Zulu
I	India	R	Romeo		

Just as the CQ call is modified for use in voice communications, the RST signal report is similarly modified by eliminating the report for tone quality. Signal reports are also supplemented with an S-Meter signal report, although such reports are generally meaningless. A much more meaningful report is how many S-Units or decibels a particular signal is above the ambient noise level, as shown by an S-Meter. If the noise level is at S-7, for example, and the received signal is above that at S-9, say so!

FM Repeaters

FM repeaters exist on every populated ham band above 29 MHz. The popularity of FM voice repeater operation rose dramatically during the 1970s. Today the amateur 2-meter band is reaching complete saturation in many areas.

A repeater is an amateur station that receives radio signals on one frequency (called an input frequency) and simultaneously retransmits those signals for greater range on another frequency (called an output frequency). The difference between input and output frequencies is called a "split" and is usually 600 kHz on the 2-meter band and 5 MHz on the 70-cm band. The repeaters on the 2-meter band have inputs 600 kHz lower than their output frequency below 147 MHz, and inputs 600 kHz higher than their outputs above 147 MHz.

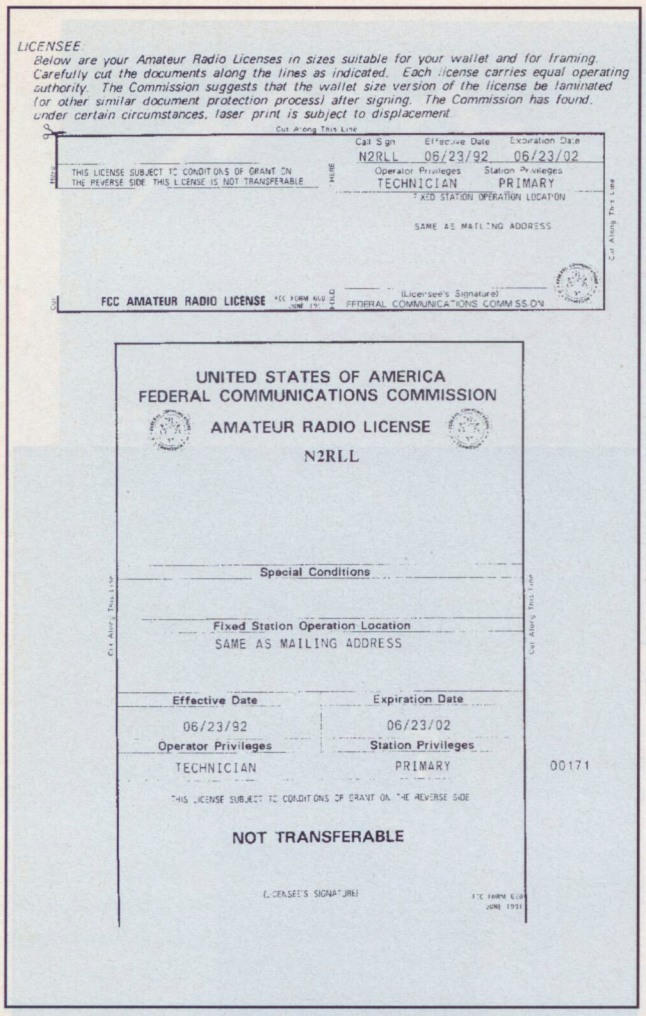
Since repeaters operate on VHF bands and above where radio signals propagate over essentially line-of-sight paths, repeater antennas are installed on top of tall towers, buildings, and mountain tops. Repeaters extend the range of low-power portable and mobile transceivers, making such low-power FM communications practical over distances of 50 miles or so. Some repeaters also have autopatch features which interface the repeater controller with a telephone line. This allows hams to make telephone calls from their transceivers if necessary.

Since repeaters are communications resources that must be shared with hundreds, or even thousands, of amateurs within the coverage area of the repeater, certain guidelines should be followed when using them. First of all, it's considered bad operating practice to call CQ through a repeater system. If you wish to make contact with anyone who may be listening to the repeater, simply announce that you are monitoring the repeater. Then, if anyone wishes to talk with you, they can call you.

For example, "KD2BD monitoring N2IRO repeat" is adequate for establishing a contact through the N2IRO repeater. Remember to keep your calls short. Emergencies don't wait for long-winded calls to be completed.

All transmissions through a repeater should be kept short. Repeaters are required by FCC regulations to have timers in their controllers that limit their transmission time to a maximum of three minutes, regardless of how long someone may be transmitting on its input frequency. A repeater will be "timed out" by excessive activation time by a user. This means it will go off the air and remain silent until its input frequency is clear, then reset itself to once again accept signals on its input for repeating.

Repeater systems use transmitter power levels from about 10 to several hundred watts. If you're using a low-power handheld transceiver and you find the reception of a repeater is weak and noisy, your chances of being heard by the repeat-



LICENSEE

Below are your Amateur Radio Licenses in sizes suitable for your wallet and for framing. Carefully cut the documents along the lines as indicated. Each license carries equal operating authority. The Commission suggests that the wallet size version of the license be laminated (or other similar document protection process) after signing. The Commission has found, under certain circumstances, laser print is subject to displacement.

Cut Along This Line

Call Sign	Effective Date	Expiration Date
N2RLL	06/23/92	06/23/02

THIS LICENSE SUBJECT TO CONDITIONS OF GRANT ON THE REVERSE SIDE. THIS LICENSE IS NOT TRANSFERABLE.

Operator Privileges	Station Privileges
TECHNICIAN	PRIMARY

FIXED STATION OPERATION LOCATION

SAME AS MAILING ADDRESS

FCC AMATEUR RADIO LICENSE

(Licensee's Signature)

FEDERAL COMMUNICATIONS COMMISSION

UNITED STATES OF AMERICA
FEDERAL COMMUNICATIONS COMMISSION

AMATEUR RADIO LICENSE

N2RLL

Special Conditions

Fixed Station Operation Location
SAME AS MAILING ADDRESS

Effective Date	Expiration Date
06/23/92	06/23/02
Operator Privileges	**Station Privileges**
TECHNICIAN	PRIMARY

00171

THIS LICENSE SUBJECT TO CONDITIONS OF GRANT ON THE REVERSE SIDE

NOT TRANSFERABLE

LICENSEE'S SIGNATURE

Your amateur radio license has finally arrived! You've earned your license, but you still have to earn respect on the ham bands. Learn to be a good operator!

er are slim. You should, therefore, avoid using a repeater if you find its signal quality is marginal, since your signal through the repeater will probably be worse.

Most FM repeaters can be accessed by a carrier on their input frequency with sufficient signal strength to open the squelch of the repeater receiver (carrier access). But a growing number employs a Continuous Tone-encoded Squelch System (CTCSS) that requires users to transmit a low amplitude, sub-audible audio tone along with their transmit audio to access the repeater. The standard Electronic Industries Association (EIA) frequency codes, along with their Motorola alphanumeric designators, are as follows (check your transceiver's manual for instructions on properly encoding a CTCSS code into your transmission):

67.0 Hz - XZ	97.4 Hz - ZB	141.3 Hz - 4A	206.5 Hz - 8Z
69.3 Hz - WZ	100.0 Hz - 1Z	146.2 Hz - 4B	210.7 Hz - M2
71.9 Hz - XA	103.5 Hz - 1A	151.4 Hz - 5Z	218.1 Hz - M3
74.4 Hz - WA	107.2 Hz - 1B	156.7 Hz - 5A	225.7 Hz - M4
77.0 Hz - XB	110.9 Hz - 2Z	162.2 Hz - 5B	229.1 Hz - 9Z
79.7 Hz - WB	114.8 Hz - 2A	167.9 Hz - 6Z	233.6 Hz - M5
82.5 Hz - YZ	118.8 Hz - 2B	173.8 Hz - 6A	241.8 Hz - M6
85.4 Hz - YA	123.0 Hz - 3Z	179.9 Hz - 6B	250.3 Hz - M7
88.5 Hz - YB	127.3 Hz - 3A	186.2 Hz - 7Z	254.1 Hz - 0Z
91.5 Hz - ZZ	131.8 Hz - 3B	192.8 Hz - 7A	
94.8 Hz - ZA	136.5 Hz - 4Z	203.5 Hz - M1	

If you're communicating through a repeater from a mobile or fixed station location, you should monitor the input frequency of the repeater. This way you can determine whether you can copy a station directly without going through the repeater. If so, it may be possible to establish contact with the station on a simplex frequency. Since repeaters are shared communications resources and are limited in number, you should not use a repeater unless you need to.

If you're listening to a repeater and want to join the conversation or to briefly interrupt the communications taking place, simply wait for the person transmitting to stop, then announce your call sign. The people on the repeater will hear you and allow you to break in with your call. Don't just inject the phrase "call please" into a repeater contact, since this phrase alone is an unidentified transmission and forbidden by FCC rules. Use the word "break" only in emergencies.

FM Simplex

Simplex (non-repeater) FM communication on 2-meters and above is relatively straightforward. The only issue to be concerned with is the frequency you operate on. Stay away from frequencies assigned to repeaters in your area to avoid interfering with them and their users. The most popular simplex frequencies are as follows:

146.520 MHz	147.420 MHz	147.510 MHz
146.535 MHz	147.435 MHz	147.525 MHz
146.550 MHz	147.450 MHz	147.540 MHz
146.565 MHz	147.465 MHz	147.555 MHz
146.580 MHz	147.480 MHz	147.570 MHz
146.595 MHz	147.495 MHz	147.585 MHz

Although the accepted FM simplex frequencies vary from area to area depending upon local options, you should avoid the 144 MHz segment since it's filled with weak-signal SSB and CW operations. Also try to avoid the 145.800 MHz to 146.000 MHz region which is allocated for OSCAR satellite radio links.

These operating hints should help newcomers get a feel for some of the accepted operating procedures for the amateur bands. See you on the air! ■

For Further Information Consult the Following Related Books

The ARRL Operating Manual, published by American Radio Relay League (ARRL), 225 Main Street, Newington, Connecticut 06111.
The ARRL Handbook, also ARRL.
The ARRL Repeater Directory, ARRL.
The VHF "How To" Book, published by CQ Communications, 76 N. Broadway, Hicksville, NY 11801.
The Packet Radio Operator's Manual, also CQ Communications.
Ham Radio Horizons: The Book, also CQ Communications.

In Review: The TRC-225 Handheld CB

By Harold Ort, N2RLL

Five-watt CB walkie-talkies are nothing new. They've been around for years and have gotten smaller, more compact, sleek-looking, and efficient as time went by. Contrary to what some folks believe, there *is* a difference in CBs; they're not all created equal!

CB operators are always looking for a new "improved" or user-friendly rig. The Radio Shack TRC-225 certainly fits the bill. The unit gives you a lot in the palm of your hand!

This full-featured CB walkie-talkie operates on all 40 CB channels with the maximum power allowed by law, 5 watts. Actually, the power output of "5-watt" CBs is more like 3-4 watts (on high power selection) and 1-2 watts on low power. While using the lower power setting conserves battery power, let's face it, most of us will use a CB walkie-talkie on the high setting, choosing instead to replace or recharge the batteries regularly.

Some Features

The TRC-225's handstrap adjusts to comfortably fit over the back of your hand, allowing the push-to-talk button and up/down channel selector buttons to be reached easily. The controls are easy to operate, even in the dark. The power saving feature turns the channel display off while in the receive mode. To see what channel you're on, either click the transmit button or press the up or down channel selector. The LED indicator will light briefly. At night, this channel indicator is plenty bright. Outdoors, however, especially on a bright sunny day, the display was somewhat difficult to see; a minor drawback to an otherwise superb transceiver. There's also a red transmit light to the left of the channel window and battery light to the right. The battery light comes on when your batteries need recharging or replacement.

How Does It Perform?

Perhaps as important as how well the transmitter performs is how well the receiver performs. After all, if you can't hear 'em, it's no use talking to 'em. The receiver performed extremely well. Even with the squelch "full open" the annoying background noise was very low, but weak and powerful stations alike were heard quite well. The receive audio was loud and easily understood, even in noisy environments, not raspy or tinny like some walkie-talkies.

The TRC-225 walkie-talkie is a full-featured, 40-channel CB radio.

The flexible antenna (included) provided reasonably good coverage; I typically enjoyed a range of one to two miles in a wooded area as well as through most of a mobile home park in Florida. Signal reports were mostly good to excellent (of course, this would also depend on the other person's CB set-up). With the inexpensive adapter 278-208 plugged into the side of the TRC-225, you can use any outdoor CB (or vehicle) antenna that terminates with the standard PL-259 connector. That includes the Radio Shack 21-960 Deluxe Mag Mount Antenna or any other mobile antenna with the popular PL-259 end.

How Far Can You Talk?

Just as in our real-life situation above, your range will depend upon terrain. The range will be best over open water. In a city environment with many tall buildings and steel-reinforced structures, it will be much, much less. The general condition of your batteries is an important factor also, as is the height of your antenna. (Remember, when using a CB walkie-talkie, keep the antenna perpendicular to the ground for best results.) Generally, though, with the TRC-225 you can expect to achieve good communications up to a couple of miles between like units. If you're communicating with a base station located at the top of a hill, you'll get better range.

If you're looking for an inexpensive way to stay in touch while hiking, camping, boating, walking, or just out having fun with the family, the TRC-225 is what you need. But don't use the unit from inside your vehicle when trying to reach someone else on the highway. It just isn't designed to work that way. Connect an outside antenna or use a mobile CB rig designed for that purpose. You'll avoid getting tangled in the antenna cord, too!

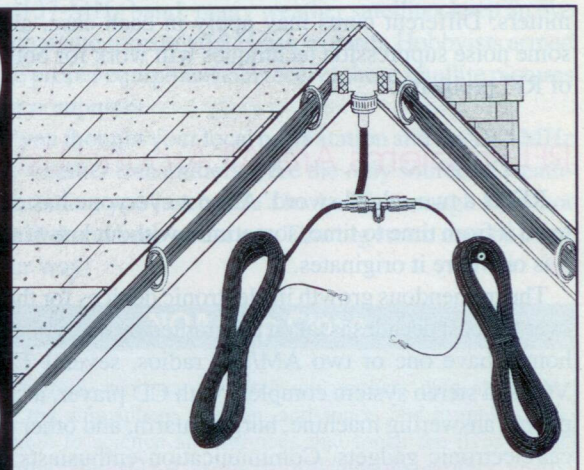
Put in the Batteries and Go for It!

The TRC-225 can be powered by a variety of sources: eight "AA" NiCd or ten "AA" alkaline batteries (not included), your vehicle cigarette lighter with the provided power cord, or a home AC outlet with the optional 273-1653 adapter.

Yes, you should read the manual that accompanies this radio (and any other electronic equipment). This manual is easily understood, even if you've never owned a CB before. A friendly reminder: while lots of folks still abuse the privilege of using our nation's airwaves—on CB and otherwise—it's not a good idea. To help stem abuses, Radio Shack has included "Plain English Rules—Citizen's Band Radio Service" in the box. Be sure to review these rules. Don't believe rumors you may hear; there are penalties for transmitting false distress signals or using profanity on the air! You don't need a license to operate the TRC-225, just common sense and a dose of courtesy.

So, load the batteries and get on the CB bandwagon with the TRC-225. It's a winner! ■

OUTDOORS



"Inverted V" shortwave antenna

World-band DXers—now hear what you've been missing! This multiple-dipole antenna is design-optimized for outstanding reception of all shortwave broadcast bands. No matching, no power source required—it's equivalent to over 190 feet of wire, yet just 65 feet in total length. Mounts easily on roof eaves or a single mast, and accepts a PL-259 plug so you can connect it to your receiver with low-loss coaxial cable. A terrific value—just $39.99 at your nearby Radio Shack.

WE BRING YOU THE WORLD.
Radio Shack®
You've got questions. We've got answers.℠

RFI And How To Fight It

We're all plagued with radio frequency interference from time-to-time. Here's what you can do to fight and win this war.

By Bill Orr, W6SAI

RFI—that's the acronym for Radio Frequency Interference. It's a complex and often puzzling problem that's been around for a long, long time. It encompasses interference *to* radios, home entertainment equipment, and telephones. It also includes interference *caused by* radios, home electronic equipment, and various appliances. And there are other sources of RFI that you'll read about in this article.

RFI can be divided into spark-discharge noise caused by electrical devices like motors and power lines, and radio, TV, stereo, and telephone interference caused by nearby transmitters. Different cures may apply in each case, although some noise suppression techniques will work for both types of RFI problems.

RFI Problems Are All Around Us!

RFI is a two-edged sword. Almost everyone has encountered it from time to time, sometimes without knowing what it is or where it originates.

The tremendous growth in electronic devices for the home over the past decades is taken for granted by everyone. Many homes have one or two AM/FM radios, several TVs and VCRs, a stereo system complete with CD player, a cordless phone, answering machine, burglar alarm, and other electrical/electronic gadgets. Communication enthusiasts add to this list an HF or VHF ham transceiver or two, shortwave receivers, and scanners. The computer buff has the computer, monitor, modem, printer, and auxiliary gear. All of this fascinating equipment can often generate RFI, and may also be susceptible to it at the same time!

External RFI Sources

RFI sources outside the home include power lines and distribution systems which can create RFI and conduct it over great distances. In addition, gasoline engines, the flickering neon sign over the corner market, electric fences, home alarm systems, and various electrical/electronic equipment of all types used in industry add to the radio/TV racket.

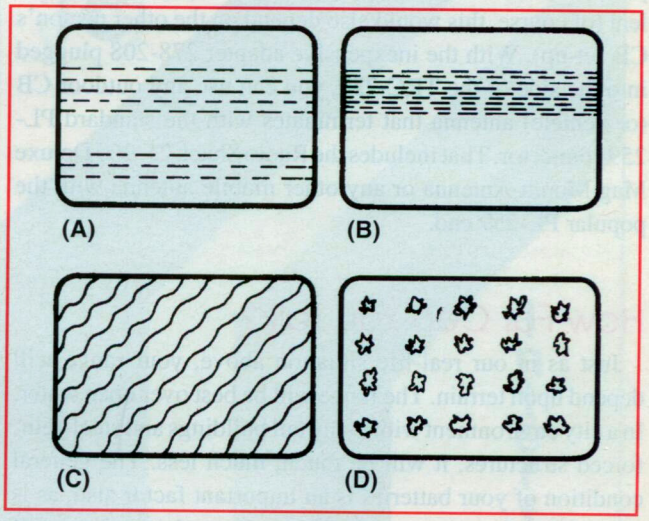


Figure 1. Typical interference seen on TV screen.a) White "shot lines" caused by sparking motor.b) Broad band of dark lines created by microwave oven.c) Pattern of wiggly lines indicates interference from radio transmitter.d) Bright "sparkles" may signify automobile ignition interference, or possible problems with satellite-fed TV signal.

Don't forget that nature can also create RFI in the form of thunder and lightning storms.

In view of all the electrical noise around us, it's a wonder that any of our exotic electronic devices work at all. RFI affects all of us, to a greater or lesser degree, since almost everything powered by electricity enters the RFI picture in one aspect or another.

Is There an "RFI Victim" in Your Home?

All cases of RFI involve both a source and recipient (known in the trade as the "victim") of the interference. Sometimes the interference can be suppressed at the source; in other cases, it's necessary to protect the victim. In severe cases both source and victim must be filtered to reject or reduce mutual interference.

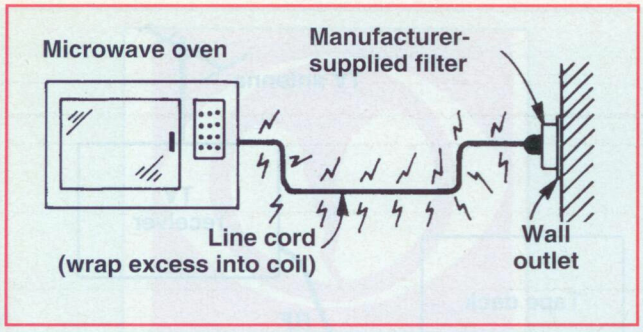


Figure 2. A plug-in interference filter blocks microwave oven interference from passing down the line cord and into a TV or radio. A filter supplied by microwave manufacturer often mounts directly to the back of the oven.

RFI can be transmitted by radiation through space and by conduction through an electrical circuit (such as the power line) between the RFI source and the victim. The proper place to start your investigation of RFI is in your own home. Your TV set, VCR, and stereo are most sensitive to interference (Figure 1). Dashed lines across the TV screen are caused by a sparking electric motor (a shaver, blender, or mixer, for example). A broad band of horizontal lines indicates a microwave oven as the source. Wiggly lines can be caused by a nearby ham or CB transmitter. Buzzing noises in your AM/FM receiver can be traced to light dimmers, fluorescent lights, or nearby electric motors. The thermostat in a tropical fish tank or an electric blanket is often a prolific noise generator as well.

RFI Sources in the Home

Let's consider some of the everyday household appliances that can create RFI:

- vacuum cleaners
- fluorescent lights
- electric shavers
- hair dryers
- microwave ovens
- air conditioners
- electric mixers/blenders
- thermostats
- air compressors
- television receivers
- doorbell transformers
- light dimmers
- air purifiers
- computers

The list goes on and on.

Checking for RFI in Your Home

Is your home "clean" as far as RFI is concerned? You can easily check it out by turning on your TV, setting it to a low channel with the volume down, and listening to an AM radio at the same time. Tune the radio between stations so all you hear is background noise. While one person watches the TV screen and listens to the radio, a second person roams the house, turning electrical devices on and off. Make a list of all the things that cause interference to the TV or the radio.

Next, check, the instruction manual of the offending equipment. (You did save the manual, didn't you?) Most manuals list repair centers you can call for advice upon describing the problem. Often your call will bring the offer of an interference filter (sometimes for free) or written information about cleaning up the problem. If you get no help from this source, perhaps the store where you bought the item can provide assistance. If not, you'll have to solve the problem on your own. Here's where this article will help you. Let's look at some specific household devices that are the source of many RFI problems.

The Microwave Oven

The microwave oven is a well-known source of radio noise and TV interference. The oven generates hundreds of watts of raw "buzzy" RF energy that cooks your food. The internal power supply that drives the microwave oscillator is also a prolific source of radio noise. Together, these oven components can blank out radio and TV reception in your home. The interference is radiated from the oven through the air and also out the power cable.

The solution is to place the microwave as far away from both the radio and TV as you can and to put a noise filter on the line cord of the microwave (Figure 2). Some oven manufacturers will supply a suitable add-on RFI filter upon request (for a price). Wrap the excess line cord into a coil and hold it firm with 4" wire ties (Radio Shack #278-1632, listed in Table 1). This will block off interference radiated by the line and conducted down into your TV or radio.

Cleaning up RFI from Smaller Appliances

Small electric appliances, such as blenders, electric razors, vacuum cleaners, etc., which have brush-type motors are a major source of radio noise and TV interference. The sparking of the brushes of the "universal" type motor used in small appliances has become an annoying source of RFI—and it's getting worse, rather than improving. Not only do we have sparking to contend with, but also the added noise generated by the speed controller.

Add to this problem the near-impossibility of achieving any sort of motor shielding because all the newer appliances are plastic-cased (a metal-cased appliance tends to keep the internal noise from being radiated directly).

Luckily, most FM receivers are more immune to this type of noise. The AM broadcast receiver, on the other hand, is highly sensitive to noisy appliances, and even more so if the

Table 1. Radio Shack Interference Fighters

AC Interference Filter (power line), 15-1111)
VCR/TV/FM Filter, 15-579
TV Static Noise Filter (ribbon line), 15-582
Choke core, snap-together, 273-104
TV Antenna, VU-190, 15-1646
TV/FM Antenna, V-185 (15-1654)
FM Antenna, 15-1636
4" Wire Ties, 278-1632
Split-loam Tubing, 278-1624
RG-59 Coax Cable, 278-1315

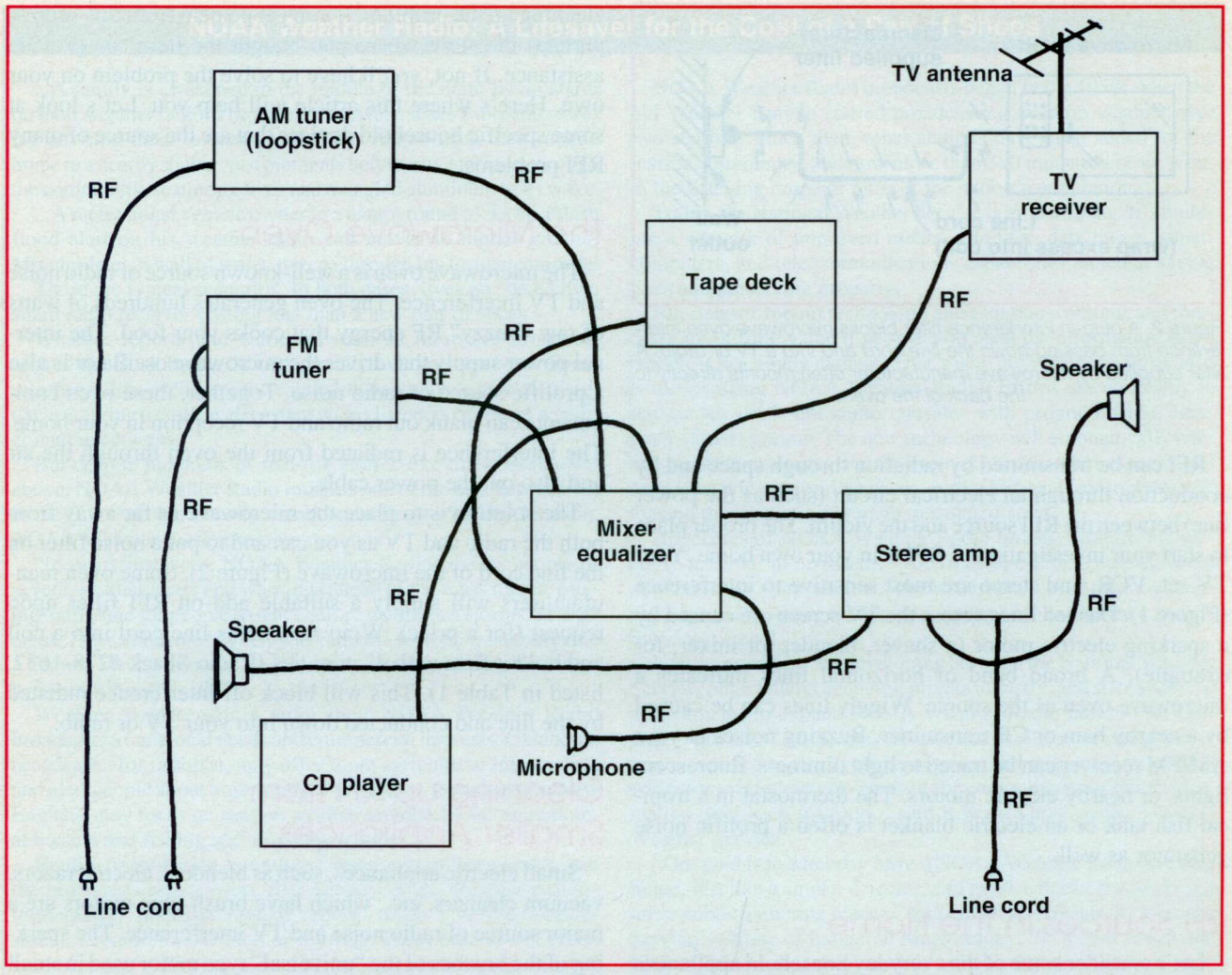


Figure 3. Haphazard wiring between entertainment units serves as a large pickup antenna system for radio (RF) interference. Shorten cables and group them into bundles for a tidy installation. Don't use line cord as an antenna for your FM tuner.

receiver's line cord is acting as the pickup antenna, as is often the case in inexpensive AM/FM sets. The noise pickup from the power line can compete directly with the incoming AM signal. The first thing to do is to not use the receiver's power line as an antenna under any circumstances. Ignore the power line antenna clip if you want to avoid noise pick-up!

Moving the noisy appliances away from the receiver often helps, but not if they're run off the same power circuit in the house. The only solution is to suppress the appliance noise before it enters the power line. A plug-in AC interference filter (Radio Shack #15-1111) placed at the offending appliance prevents the noise from passing down the line cord and, from there, into your sensitive equipment. This unit is rated up to 300 watts. In order for the filter to do its job, you must wrap the excess appliance line cord into a small coil. This prevents the cord from acting as an antenna and radiating noise, which will degrade the filter's performance. Hold the coil firm with 4" wire ties and keep the coiled line away from the filter cord.

Wall-mounted electric light dimmers are also a main source of radio noise. There's not much you can really do about a noisy light dimmer except to get rid of it, replacing it with a noise-suppressed dimmer. This change should be done *only after the electricity has been turned off* at the main power panel, as the voltage in the circuit can be lethal. It's best to have a certified electrician make the change, then you know it will be done right.

Clean up Your Stereo and TV Wiring

Unless the home entertainment center is an integrated unit, planned in advance, it's liable to end up with long wires and cables running helter-skelter between the various components. Haphazard speaker cables, line cords, input wires, and all the rest make ideal antennas to pick up noise and strong radio signals from nearby broadcast stations, CBers, and hams (Figure 3).

You can make things a lot easier for yourself if you tidy up all the random cables. They should be as short and direct as possible, and extra cable length should be wound up into a small coil and affixed with 4" wire ties. Multiple cable runs

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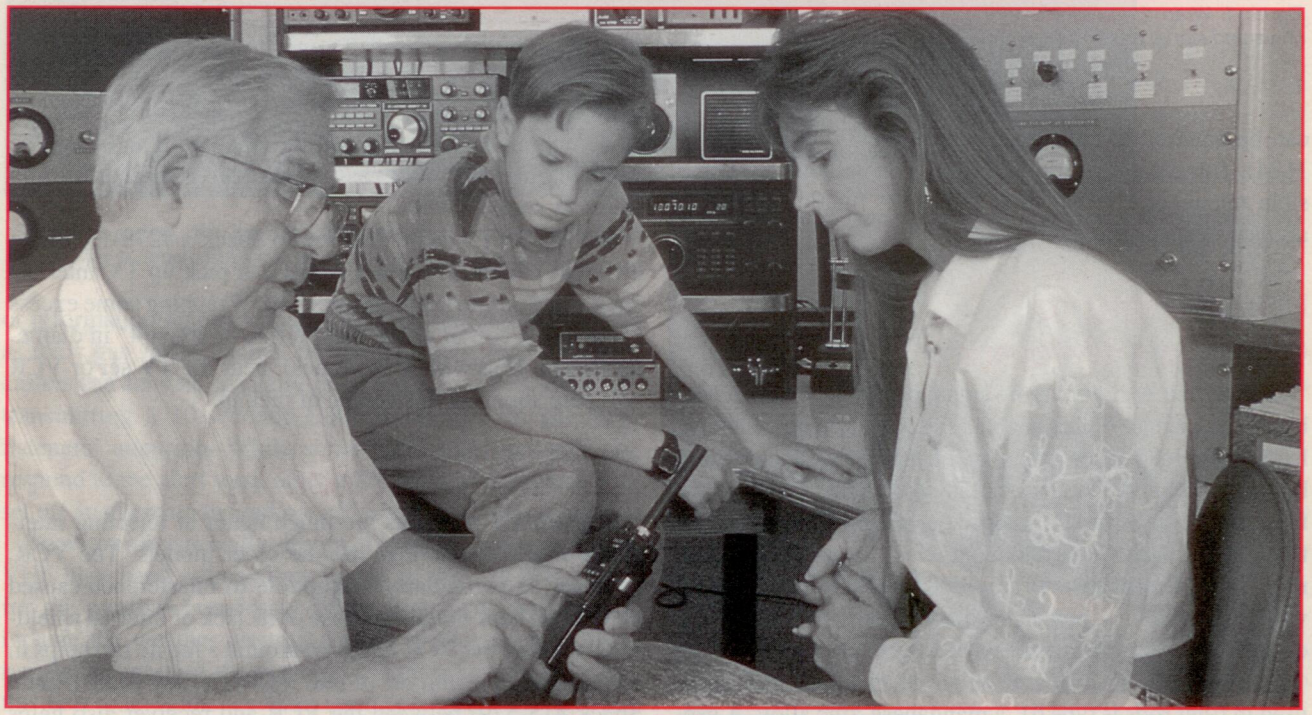

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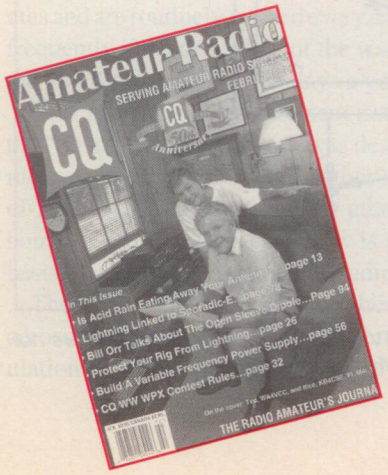

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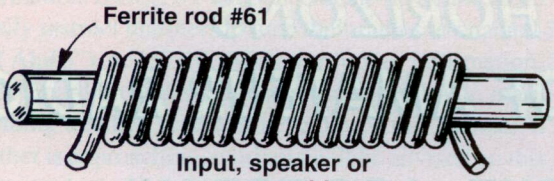


Figure 4. Wrap the power lead around a ferrite cord to choke off unwanted signal passing along wire. Hold lead on core with plastic cable ties or epoxy cement.

can be encased in split-loam tubing (Radio Shack #278-1624). This cleanup effort will leave you with the least possible amount of external wires and cables running around to act as pickup antennas.

Using Ferrites to Combat Interference

It's possible to reduce radio signal pickup of wires and cables by proper use of ferrite cores and rods. Ferrite is a black, hard, brittle substance made up of metal oxides held in a binder compound. The material is obtainable in rod or core form. Sensitive wires are wrapped around the rod or passed through the core. The ferrite material is "lossy" to radio signals. That means it absorbs any RF energy flowing along the wire, but the audio, power, or other signals pass along the conductor just as though the ferrites were not there.

Ferrites come in different mixes of material. The grade used in filter rods is type 61, a manganese-zinc alloy. A useful rod size is 7 1/2" long and 1/2" in diameter.

For radios, VCRs, stereo equipment, and television sets, 15 to 20 turns of the line cord of the device wrapped closely along a ferrite rod and held in position with 4" wire ties or bits of epoxy cement (Figure 4) may work. This will impede radio interference from passing along the line cord into your equipment.

In many cases, multiwire control wires or speaker cables must also be protected from signal pickup. Cable wires are close together and act just like a single wire as far as radio interference is concerned. Wrap each individual cable around a rod. This will suppress RFI transmission along all the cable wires. A handy device is a ferrite snap-together choke core (Radio Shack #273-104). There's no need to cut a wire or cable, merely wind it through the open core and snap the assembly together. This easy-to-use core is often placed on stereo or speaker wires.

But RG-59 TV cable (like Radio Shack's #278-1315) is a different matter. The outer shield can pick up TV interference which is carried to the receiver. Wrapping some excess cable into a coil of six to eight turns, or about 4" in diameter (again, held with 4" wire ties), near the TV set or VCR will help suppress this source of pickup.

The TV/VCR Combo

Modern TV receivers are much better at rejecting interfering radio signals than are the older models. The VCR, however, is particularly susceptible to interference caused by CB and ham signals because of its lack of internal shielding. Winding the VCR line cord around a ferrite rod helps in some cases. Placing an in-line VCR/TV/FM filter (Radio Shack #15-579) between the VCR and receiver also helps reduce interference (Figure 5).

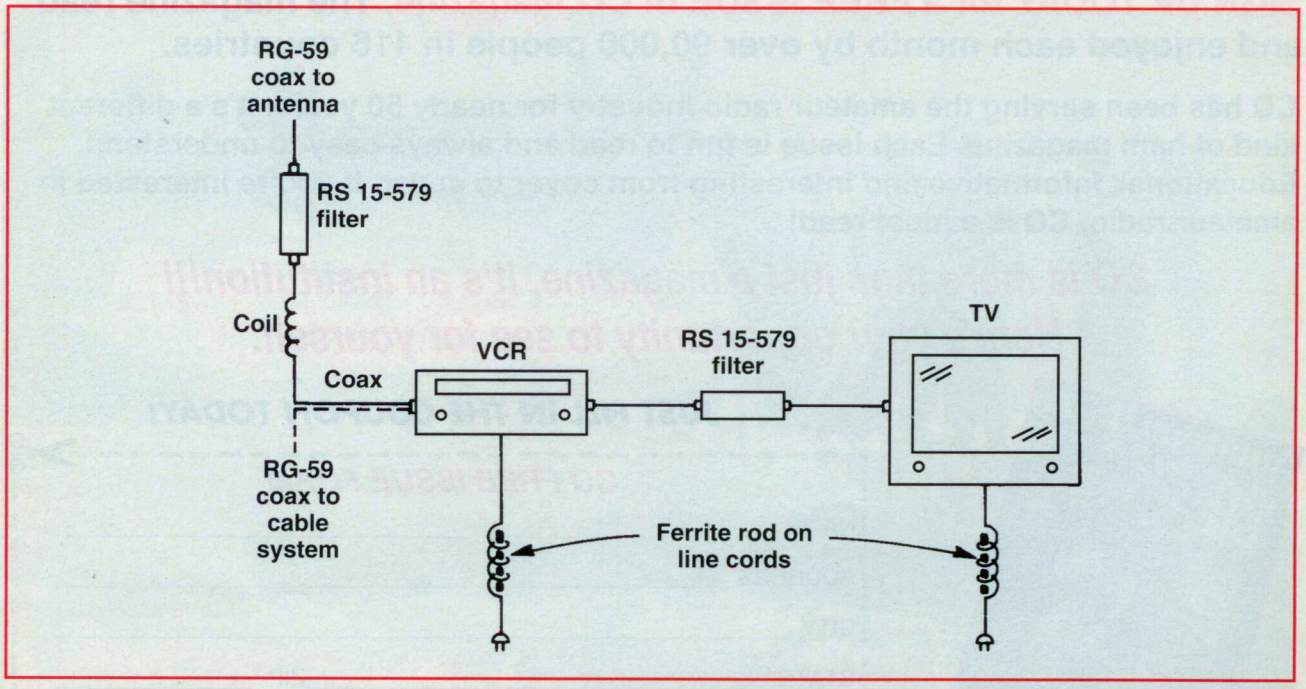


Figure 5. Placing an in-line filter in antenna coax and interconnecting coax between VCR and TV helps cut interference; filters are not required in coax to cable systems. Ferrite rod chokes on line cords may also be required.

Table 2. Additional Interference Fighters—Telephone Line Filters

Filter TP-5032, available from TCE Laboratories, 2365 Waterfront Park Drive, Canyon Lake, TX 78133, 210-899-4575, 210-899-4575.

Filter RF-1 (in-line) and Filter RF-2 (in-telephone cable), available from K-COM Co., Box 82, Randolph, OH 44265, 216-325-2110.

RFI-Suppressed Telephones (internally modified), available from TCE Laboratories, 2365 Waterfront Park Drive, Canyon Lake, TX 78133, 210-899-4575 and from PRO Distributors, 2811-74th Street, Lubbock, TX 79423, 800-658-2027.

Ferrite Rod: Material 61, 7.5" X 1/2", part no. R61-050-750, available from Amidon Associates, 2216 East Gladwick Street, Dominguez Hills, CA 90220, 310-763-5770.

In addition to lead pickup, radio interference can reach the TV or VCR through the antenna. For coax lead-in, use the in-line filter. For ribbon (300-ohm) line, use Radio Shack TV static/noise filter #15-582.

Interference and TV/FM Reception

If you live in a TV fringe area, a more powerful antenna can help you override local interference. The Radio Shack VU-190 (#15-1646), for example, can provide improved TV reception over a smaller antenna. The V-185 antenna (#15-1654) will provide superior VHF TV/FM stereo reception. For local omni-directional FM reception, use the 15-1639 antenna, and for distant FM reception, the 15-1636 should do the job. All of these antennas will boost the received signal and provide an improved signal-to-interference ratio. You should remember that these TV antennas are quite directional and must be aimed at the distant station and positioned for maximum reception.

Cable TVI

Is it possible to receive interference from a local ham or CB operator if you're on a cable TV system? You bet it is! The cable system is a closed one. That is, it doesn't respond to signal pickup outside the system since the signals are carried on a shielded cable. In the field, however, it's possible to have breaks in the cable system. These can let spurious signals into the system and "leak" cable signals into the environment, which can cause problems to other radio services. Cable problems should be immediately reported to the cable operator, who's regulated by FCC rules concerning spurious radiation from the line. When radiation from the cable is corrected, signal pickup by the line will also be eliminated.

Telephone Interference—the FCC Survey

Telephone interference is commonly caused by a nearby ham or CB operator, but can also be caused by a nearby powerful broadcast station. Signal pickup occurs indirectly via the telephone line which acts as a big antenna, or directly by the intricate circuits within the telephone or answering machine itself. It's difficult to determine which of these pickup sources, if not both, is the cause of the problem.

The FCC recently conducted an informal telephone interference survey, brought about by more than 25,000 complaints received per year from individuals experiencing interference. The survey was conducted across the country, based upon a random selection of complaints.

The survey examined the type of station (amateur, CB, broadcast, etc.) causing the interference and the type of telephone involved. Several commercially-available telephone interference filters, plus so-called "bullet-proof" interference-free phones, were tested for the study, too.

The results showed that the power level of the transmitting station is not the primary factor in causing interference, as one-third of the stations in the survey operated with less than 10 watts, while another third of the interfering stations were broadcast stations using upwards of 3,000 watts.

Some telephones did not pick up interference, some phones caused no trouble, but affected other phones on the line, and some were interference-free.

Various telephone line filters were tried on phones receiving interference. Results were inconclusive: only about a third of the phones benefited from the addition of a line filter. Unfortunately, the limited scope of the survey did not test whether an interference-free phone would always reject interference if there were a change in the interference level or if phone placement in the home was changed.

The FCC also tested two makes of "bullet-proof" phones, especially designed to be interference-free. These phones were immune from interference virtually all of the time.

Solving Your Telephone Interference

If you're plagued by this annoying problem, it's best to start troubleshooting by eliminating the phones that don't have a problem! While the interfering signal is present, disconnect one phone at a time and see if the problem still occurs on the remaining phone(s). If removing one phone (or an answering machine or speaker-phone) solves the problem, that unit is probably the culprit. If, however, removing devices doesn't seem to be the answer, signal pickup by the telephone line may be at fault.

If telephone line pickup is the problem, various line filters are available (Table 2). These filters plug into the phone line at the instrument and suppress the interference on the line. It may be necessary to place a filter on each telephone device in your home. Wrapping the telephone cord around a ferrite rod is helpful and is often done in conjunction with a conventional filter in cases of severe interference.

Direct Pickup by the Phone

In many cases of direct pickup by the phone itself, it's impossible to get the offending signal out of the system. Only

a qualified telephone technician can dig into the innards of the phone and install proper filters. Usually it's cheaper to junk the phone and get another which is less susceptible to RFI. The same holds true for certain makes of speaker phones and answering machines.

Power Line Interference

A particularly nasty type of interference can be generated by power lines. A leaky insulator, or loose, sparking hardware on a pole can spread radio noise and TV interference over a large area. You can often trace this noise by tracking it with your car radio. Drive around your neighborhood and listen to the noise. It will rise and fall as you move about. To pin-point the offending power pole itself with your radio is difficult and time-consuming, often best left to the power company. A complaint to the company about power line noise will (sometimes) result in an investigation and repair crew to clean up the problem, but such complaints are usually low on the company's list of day-to-day problems! If you *can* locate the exact power pole causing the interference, report the pole number (on a metal plate attached to the pole) as it may help to speed up correcting the problem.

A better way to locate the source of the noise is by using a portable, battery-operated multiband radio. Power line noise is worse at low frequencies and grows weaker in intensity as the listening frequency is raised (Figure 7). The idea is to drive about listening to the noise. As the noise grows stronger, gradually increase your listening frequency. When you get close to the noise source, you'll be able to hear it in the VHF bands. The aeronautical band (110–130 MHz) is an ideal place to search, as the noise field in that band is usually limited to a few hundred feet from the source. With any luck, you should be able to locate the line noise within one or two power poles. The Radio Shack AM/VHF-Air receiver (#12-601) is a good receiver for this job.

Power line noise is tough to locate. It can repeat itself along the line, and you may find a false source while the real one is some distance away (Figure 8). But a little patience in trac-

Ham and CB Interference

Any ham or CBer with a visible antenna is at once suspect by a neighbor who sees unusual lines on his TV, hears weird voices on the telephone or funny sounds in the stereo. Although some hams are unwise in their operating habits, if the radio operator is using the equipment properly, a neighbor shouldn't experience problems with entertainment equipment. Many CBers can cause interference by using illegal power amplifiers, and the FCC is inundated with complaints about these pests.

But the majority of radio operators are clean "interference-wise," providing they take proper precautions to filter their equipment. The ham or CB transmitter should be equipped with a low-pass filter in the antenna circuit that will suppress any transmitter harmonics that may fall in the TV or FM channels (Figure 6). Sources of these filters are also listed here (Table 3).

Wrapping the line cord of the transmitting equipment around a ferrite rod helps prevent the signal from running back down the power line. And the wise operator will place his transmitting antenna so that it's not near power lines or nearby TV antennas. But, this is often easier said than done.

The proper operation of a ham or CB transmitter equipped with an antenna filter, and operating within legal power limits, can go a long way towards elimination of neighborhood interference. Good relations with neighbors will pay big dividends when RFI problems arise. The neighbor who finds his new, expensive TV or stereo picking up signals from a nearby ham or CB operator quickly assumes the station operator is at fault and isn't happy with the suggestion that the new entertainment equipment may not be able to reject strong, nearby signals on its own! Friendly cooperation between the operator and neighbor solves more problems than head-to-head confrontation.

Table 3. Low-pass Transmitter Filters

These are available through many amateur radio distributors. Models of filters include the following:

Bencher, Model YA-1
Barker & Williamson, Model FL-10/1500
Oak Bay Technologies, Model LP-11P
Viking, Model 020-001

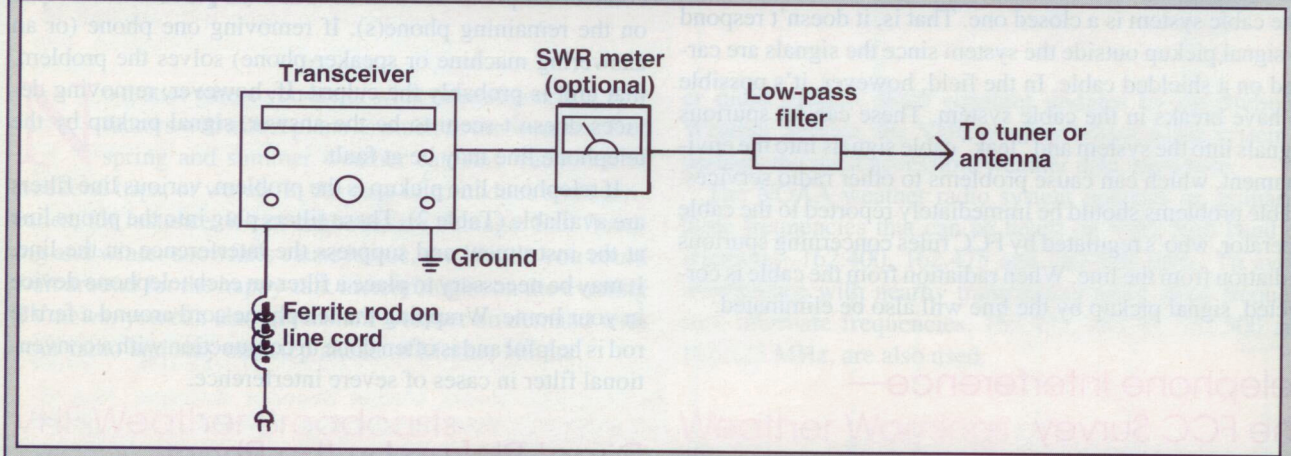


Figure 6. A low-pass antenna filter prevents transmitter harmonics from being radiated by the antenna. A line cord choke prevents the signal from entering the power line.

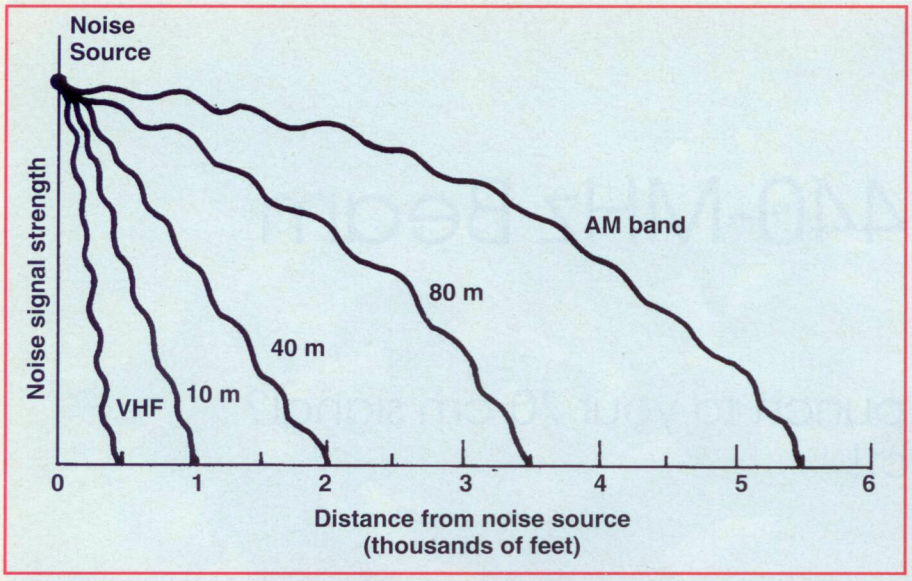
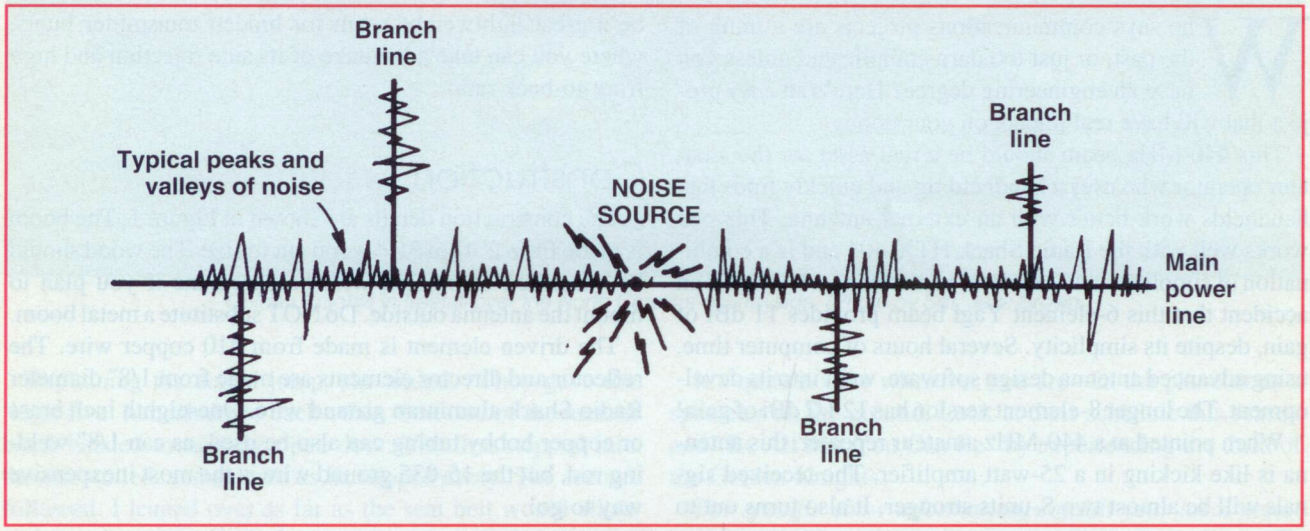


Figure 7. The higher the frequency of reception, the closer the receiver to the noise source. The VHF aviation band is useful to zero in on power line noise.

Figure 8. Noise peaks and valleys occur along the power line and extend into branch lines. Areas of loud noise may fool an investigator who hasn't traced a sufficient number of noise peaks to locate the ultimate source.



ing this type of interference will pay big dividends in the long run. You've done your part—now it's time for the power company to act!

Finally...

RFI problems are tricky and must be solved on a case-by-case basis. A lot depends upon factors beyond your control. For example, homes wired with knob-and-tube electrical circuits are more prone to RFI pickup and radiation than homes wired with Romex or other prepared cable. Homes with electric cables encased in metal conduit are the best, from an RFI point of view, as they are easy to RFI-proof. It's a matter of how much interference the power line is capable of picking up and passing along to sensitive equipment.

Underground primary circuits are less prone to generate power line noise than are older circuits strung on power poles. And, to top it off, some brands of home entertainment equipment are less prone to RFI problems than others. RFI susceptibility also varies between different models made by the same manufacturer.

In spite of all these roadblocks, it is possible to clean up a tough interference problem. Some ham and CB radio clubs have interference committees that provide knowledge and assistance in cases that involve transmitter interference. Books are available that are a great help in difficult situations. Good luck, and good listening! ■

Each Interference Problem Is Different

It's impossible to cover all bases of RFI in a short article. Each case seems to be unique. The more you know about the general subject, however, the better you'll be able to combat and solve the problem of RFI.

Several books have been written on the subject. Following are two of the better ones:

Interference Handbook, Nelson, William, 2nd edition, Published by Radio Amateur Callbook, Box 2013, Lakewood, NJ 08701, 908-905-2961.

Radio Frequency Interference: How to Find It and Fix It, published by ARRL, 225 Main St., Newington, CT 06111 203-666-1541.

A Simple 440-MHz Beam Antenna

Want some extra punch to your 70-cm signal? Try this easy project!

By Kent Britain, WA5VJB

Who says communications projects are a thing of the past, or just too darn complicated unless you have an engineering degree? Here's an *easy* project that will have real impact on your hobby.

This 440-MHz beam should be a real asset for the amateur operator who uses a handheld rig and quickly finds that handhelds work better with an external antenna. This one works well with the Radio Shack HTX-404 and is a combination of simplicity and excellent performance. It was not an accident that this 6-element Yagi beam provides 11 dBi of gain, despite its simplicity. Several hours of computer time, using advanced antenna design software, went into its development. The longer 8-element version has 12 1/2 dBi of gain!

When pointed at a 440-MHz amateur repeater, this antenna is like kicking in a 25-watt amplifier. The received signals will be almost two S-units stronger. It also turns out to be a great lightweight beam for hidden transmitter hunts, where you can take advantage of its side rejection and high front-to-back ratio.

Construction

The construction details are shown in Figure 1. The boom is made from 2' 4" of 3/4" wood cut to size. The wood should be varnished or painted with polyurethane if you plan to mount the antenna outside. Do NOT substitute a metal boom.

The driven element is made from #10 copper wire. The reflector and director elements are made from 1/8" diameter Radio Shack aluminum ground wire. One-eighth inch brass or copper hobby tubing can also be used, as can 1/8" welding rod, but the 15-035 ground wire is the most inexpensive way to go!

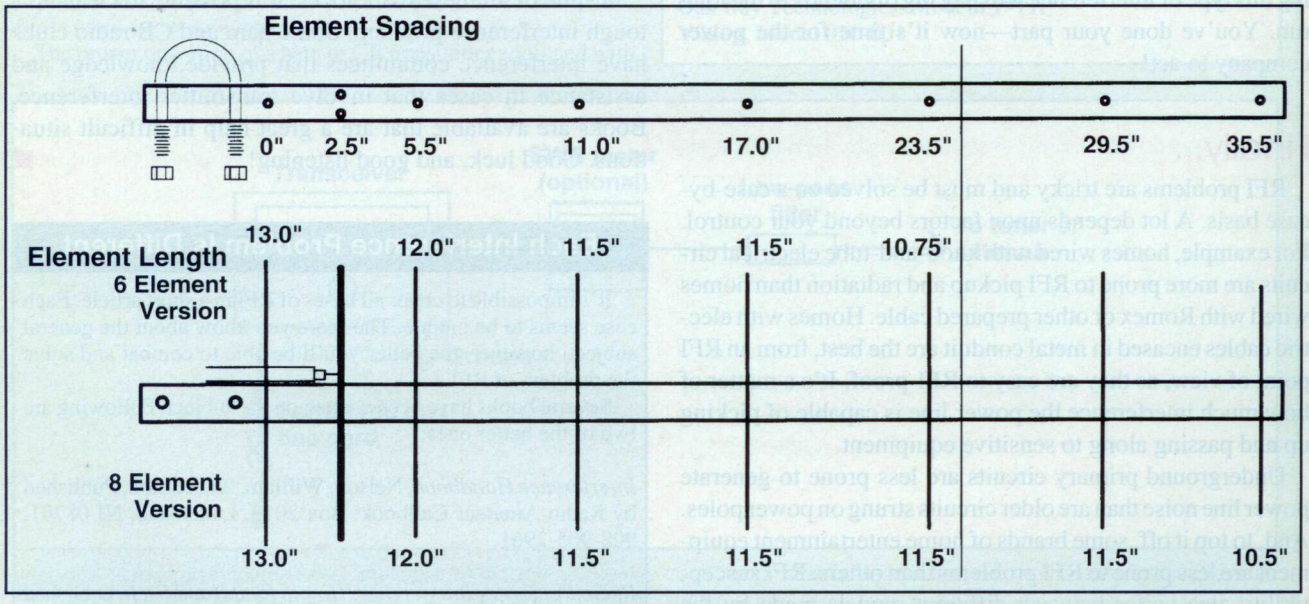
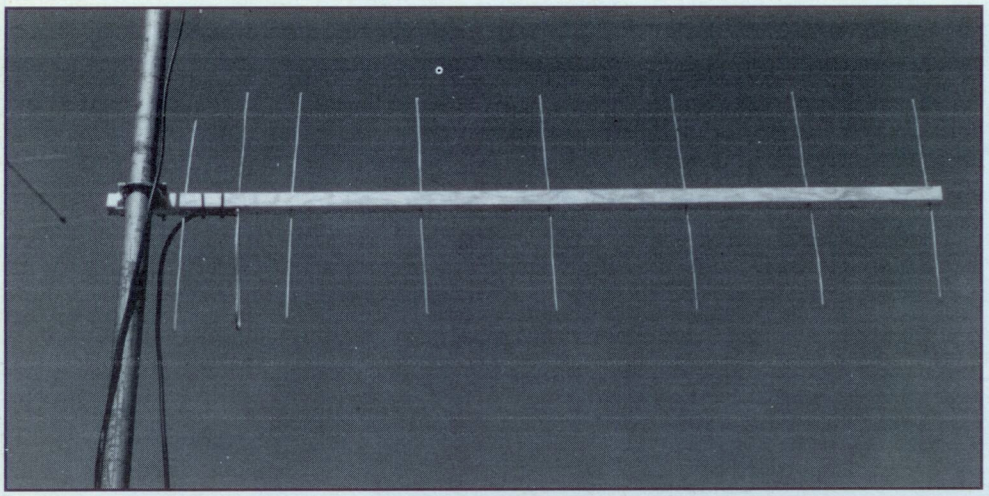
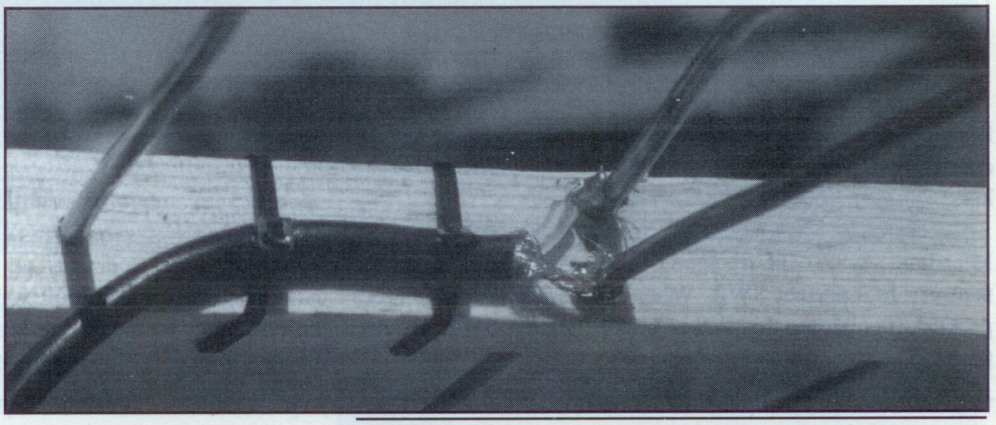


Figure 1. Here the beam antenna is shown mounted to a mast.



Both Yagis shown mounted to a pole with the U-bolts.

A close up showing soldering detail on the driven element, and the wire ties which hold the coax to the wood boom.



Parts List for the 400 MHz Beam Antenna

Quantity	Description	Catalog No.
1	40' roll aluminum ground wire	15-035
1	U-bolt and clamp	15-826
1	Set of UV stabilized wire ties	278-1652
As Req.	RG-58 coax (sold by the foot)	278-1314
1	BNC coax connector	278-103 or 185
1	4 feet. of 3/4" by 3/4" wood	
As Req.	2 feet of #10 solid copper wire	

Cut the elements according to the dimensions shown in Figure 1 and detailed Figure 2 for the antenna you're making. Make your measurements carefully! The beam's performance depends on accuracy.

Drill the 3/4" wood boom as shown, starting with the clamp mount first, using a 5/16" drill bit. Next, drill the holes for the antenna elements using a 1/8" drill bit.

Slide the elements into their holes, except for the driven element, and apply a drop of glue to both sides of the boom. Radio Shack silicone rubber, 64-2314, or one-minute epoxy, 64-2326, works well.

Mount the driven element as shown in the Figure 2 detail. Strip one end of the RG-58 coax, and solder the shield and center conductors to the driven element as shown. Mount a

INDOORS

Amplified antenna packs a punch!

Shortwave fans—hear more stations, more clearly! This compact, 9V battery-powered antenna amplifies signals up to 20 dB for reception that rivals outdoor longwires. Its tunable preselector *peaks* your selected frequencies and *rejects* unwanted ones, dramatically improving reception of weak signals and giving already-strong stations crystal clarity! Plugs into radio's external antenna jack, tunes 4-30 MHz. With 29" telescoping whip. Just $29.99—great value!

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You've got questions. We've got answers.℠

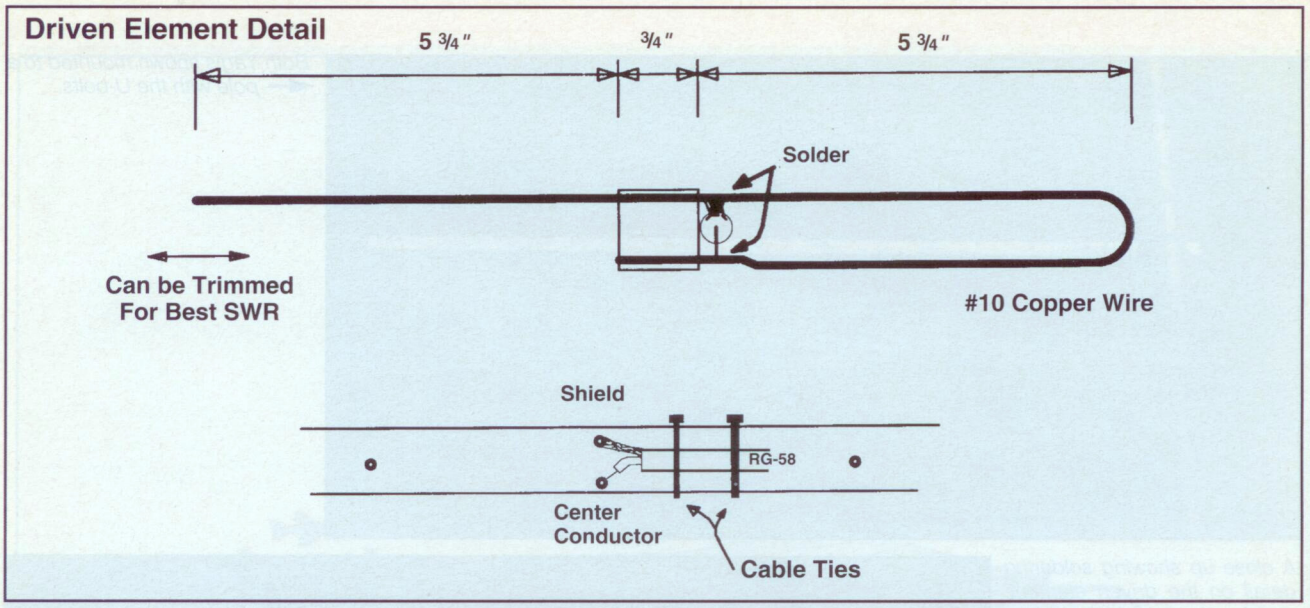

Figure 2. A close-up showing how the RG-58 is soldered to the driven element.

BNC connector to the other end of the RG-58 coax. (BNC connectors are used on Radio Shack and most other handhelds for their antennas.)

With a UHF SWR meter, such as the new Radio Shack Micronita 19-320, the free end of the driven element can be trimmed to a perfect SWR. When it's carefully built to the proper dimensions, this antenna will have an SWR of less than 1.5 to 1.

A Unique Yagi

This beam antenna is also innovative in that its impedance is 50 ohms. Normally, a Yagi antenna with a folded dipole for the driven element has an impedance of 300 ohms. By using part of a folded dipole for the driven element and using the computer to model the loading effect of the other elements, a direct 50-ohm impedance match is achieved! ■

Hams: Taking your 2-meter HT on the road? Here's

More Power "2" You!

Now you can boost your signal and enjoy crisp, clear reception when operating your 2-meter handheld transceiver from a vehicle.

Radio Shack's new 2-meter power amplifier is designed specifically for mobile use. Its superbly engineered front end teams a helical receive filter that dramatically reduces intermod distortion with a compensating preamp that maintains received-signal strength. It's ideal for RF-crowded urban areas where multiple out-of-band signals can create annoying interference.

This $1\frac{3}{8} \times 3\frac{15}{16} \times 6\frac{1}{8}$" powerhouse accepts 0.5 to 5 watts input and outputs a full 30 watts—plenty of power to carry you to distant repeaters. Team it with Radio Shack's HTX-202 transceiver and $\frac{5}{8}$-wave magnetic-mount antenna and you've got a mobile rig that's hard to beat!

Get the most from your HT today with the 2-meter power amplifier, just $119.99.

For 2-meter VHF (144-148 MHz) band, FM only. Requires 13.8VDC.

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Radio Extension Speaker
Magnetic Mount Mobile Scanner Antenna
Clip-On Mini Speaker attaches to collar or lapel
Discone Scanner/Ham Roof Antenna

We're America's Supplier of Communications Accessories!

Communications enthusiasts trust Radio Shack for the "extras" they need. Take the sting out of static with one of our performance-boosting antennas for home or car. Or, add an extension speaker to keep the signals coming in loud and clear.

No matter what your favorite "band" is, Radio Shack offers a complete line of receivers and accessories to help you get the most from your home, mobile or portable communications equipment. Drop by today—we're right in your neighborhood!

Radio Shack®

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ETC. ETC. ETC.

Radio Kits For Kids

Take a favorite childhood memory and pass it along—you don't even have to wind your own coils.

By Bill Price, N3AVY

The last radio I built was a crystal set—really a germanium diode set—as a project for the Cub Scouts in my den. My own Cub Scout is now 20. A generation before that, a neighbor (the first "ham" I ever met—K3DEY) did that very same thing for me. Later, my dad strung what seemed to be a mile of wire so I could hear WIBG's Joe Niagara play what we now call "oldies" on the crystal set that I built by myself. Cat's-whisker doo-wop...it's one of those memories I'd never give up.

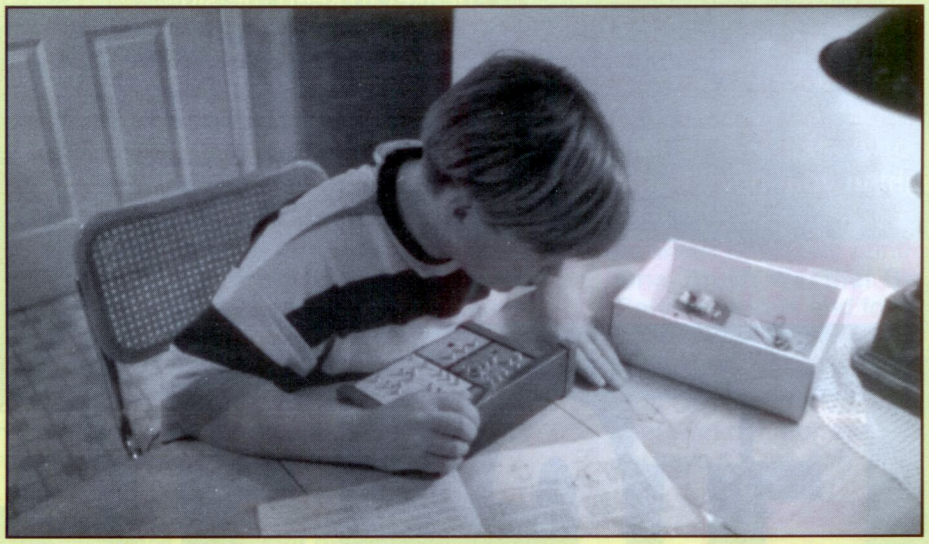
For more than a year, I have thought about getting a radio kit at the local store, but with my collection of shortwave receivers, AM/FM radios, scanners, and ham gear, I couldn't invent an honorable way to get one of those kits into the house. I had put the idea aside until some folks from Radio Shack saw fit to provide me with three different radio kits so I could write about them.

Let the Building Begin

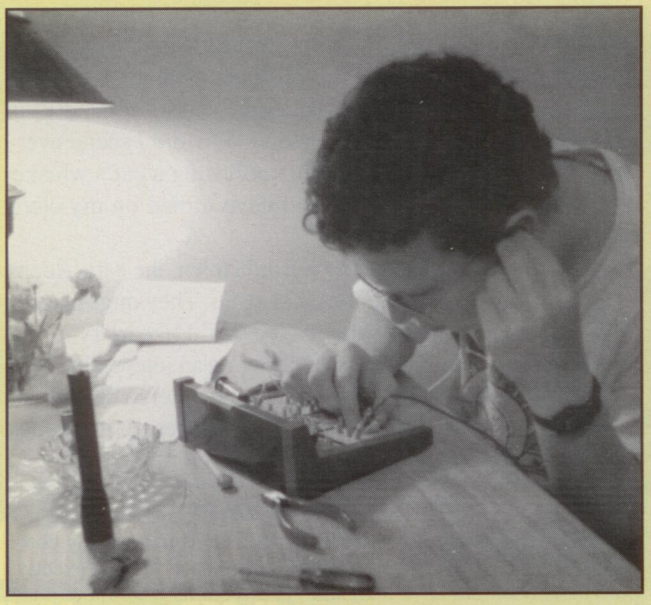
My first step, the scientific selection of young kit-builders, was made using the "Honey, who do we know with kids who'd like to build a radio?" approach. The rest of life should be so easy. Yes, they'd love to do it. No, none of them has ever built a radio before, and what time should they get here? I worried for a while that they'd all want the same kit (there were three different ones—an AM/Shortwave, an AM/FM, and an AM/VHF) but it turned out that everyone got what they wanted with no disagreement. (I checked for a moment to see if I had become Ward Cleaver, but I wasn't wearing a suit and June was not in the kitchen baking cookies.)

After I had arranged to have three kids from the neighborhood come over and drop tiny parts all over the kitchen, I wondered whether I shouldn't just build the kits myself. The first young Marconi would be at my door in an hour. I didn't open the boxes until the kids arrived, and my blind faith was justly rewarded.

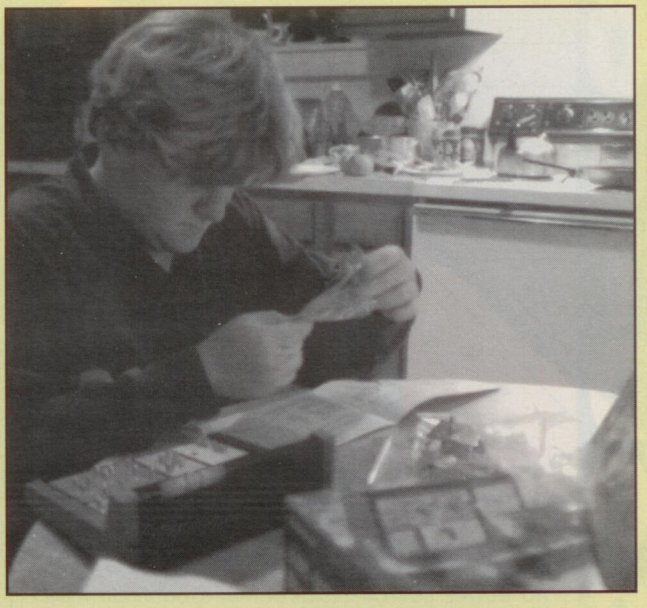
I found out immediately that the kids were smarter than I had given them credit for, and that the instructions were clearer than I had expected. My job description changed from troubleshooter to "hander of tools," and occasionally to verifying that the three young scientists did indeed have the right part and were connecting it correctly. My years of communication experience were completely unnecessary in helping



Jesse Rollinger organizes the parts in his radio kit. (Photo by Bill Price.)



The sounds of success in Ben Frary's ears. His AM shortwave radio kit took about three hours to complete—it's something a young radio enthusiast can do one evening after supper. (Photo by Bill Price.)



Adam Rollinger got right down to business with his radio kit. The instructions were well written, so I simply became a "hander of tools." (Photo by Bill Price.)

the kids with these kits, except I think they liked my stories of being chief radio officer on the Ark.

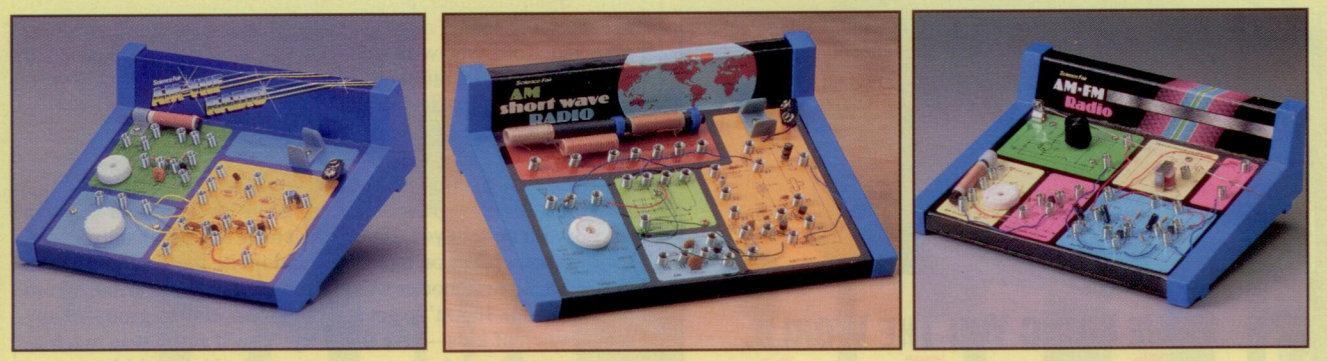
When the experimenters had a question, we referred to the instructions together, and the answer was always right there in front of us (handy when you don't want to admit you can't remember the resistor color code). I eventually realized that my real place in this project was to keep my fingers out of their work and to watch over their shoulders and tell stories like the time I built a transmitter out of a swivel chair and a peach pit, single-handedly saving the HMS Queen Mary, her crew, and passengers. I have never seen three garden variety kids (selected because my wife knew their moms) tackle a new and unfamiliar project with such dedication. It was also fun when one of their parents would drop by the construction area to ask how things were going, and hear a new techie say, "Well, I've got all the resistors and capacitors in place, and after a couple more diodes, then the transistors go in. If there's time, Mr. Price says we can start on a DC-10 he's been gathering parts for. He says we can fly it when we're done."

When the kits were complete, I had to really force myself not to be a "pushy grownup" and grab the earphone at the moment of truth—when that smile came over each of my kit builders. If the room had been dark, I'd still have seen their eyes light up.

I didn't have the kids unwind the longwire antennas that are included with the kits, because I already have a longwire antenna in my backyard. I just used an alligator-clip jumper to connect their newly-built radios to my antenna, which let us avoid climbing trees in the dark (they wanted to—I didn't). At home, they can toss the end of their antenna wire out a window or even stretch it out across the floor to get results.

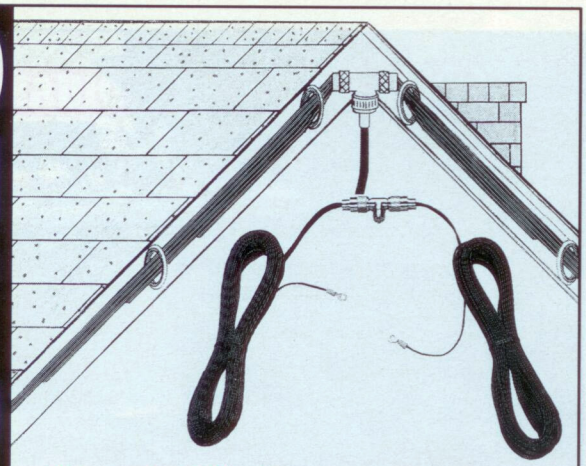
The Ultimate Reward

I know how the radios work. I know how radio waves travel, and I know how antennas work, too. What I don't know is how a tiny signal from a not-so-far away AM station can light up a kid's face while he tells you every word of a supermarket commercial as he cups his hand over the earphone—



The three Radio Shack radio kits (not shown is the Crystal AM Radio Kit): 28-163, Solderless AM/VHF Kit; 28-176,Solderless AM/Shortwave Radio Kit; and 28-175, Solderless AM/FM Kit. Each kit costs $12.99 and requires a 9-V battery.

OUTDOORS



"Inverted V" shortwave antenna

World-band DXers—now hear what you've been missing! This multiple-dipole antenna is design-optimized for outstanding reception of all shortwave broadcast bands. No matching, no power source required—it's equivalent to over 190 feet of wire, yet just 65 feet in total length. Mounts easily on roof eaves or a single mast, and accepts a PL-259 plug so you can connect it to your receiver with low-loss coaxial cable. A terrific value—just $39.99 at your nearby Radio Shack.

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INDOORS

Amplified antenna packs a punch!

Shortwave fans—hear more stations, more clearly! This compact, 9V battery-powered antenna amplifies signals up to 20 dB for reception that rivals outdoor longwires. Its tunable preselector *peaks* your selected frequencies and *rejects* unwanted ones, dramatically improving reception of weak signals and giving already-strong stations crystal clarity! Plugs into radio's external antenna jack, tunes 4-30 MHz. With 29" telescoping whip. Just $29.99—great value!

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a commercial he wouldn't even notice if it were playing on your table radio in the kitchen. Yet he hears it with the importance of a phone call from the President. What is it about a weak signal in an earphone that comes out of a handful of parts you've assembled by yourself? Why did I spend every night of the eighth year of my life adjusting a cat's whisker on a galena crystal when I could have turned on my clock radio? It's magic!

Thanks to Ben (who had help from Helen, the cat), Adam, and Jesse, I got a chance to be a kid again. They might just do it for their kids someday, and maybe you'd like to try it, too.

At least one of my builders is following an interest in shortwave listening and we're planning to add a stereo headphone jack, and later an audio amplifier and speaker to his kit. Mr. Wizard—eat your heart out. ■

Project Supervisor

What was it like to be project supervisor? First off, my congratulations to the folks at Radio Shack—each kit had exactly the parts it should have had, and the directions were more than clear. If you drop a part and your gerbils carry it off, not to worry—I don't think there's a component in any of the kits that can't be readily replaced for a few pennies at your local store.

My kit builders, Ben, Adam, and Jesse, were 14, 14, and 12 years old, respectively. They probably wouldn't have needed me around at all except that I could hand them needle-nose pliers, wire cutters, and phillips screwdrivers when they wanted them. I should also rise to a moment of personal privilege here and tell the world what great kids they were. Young adults, to be sure.

I did explain the difference between a polarized and non-polarized capacitor, but that was extra-credit stuff. I could have gone fishing if I'd left my pliers and screwdriver on the table. But then I'd have missed the big moment, and the brief return to my youth that's so hard to conjure up these days.

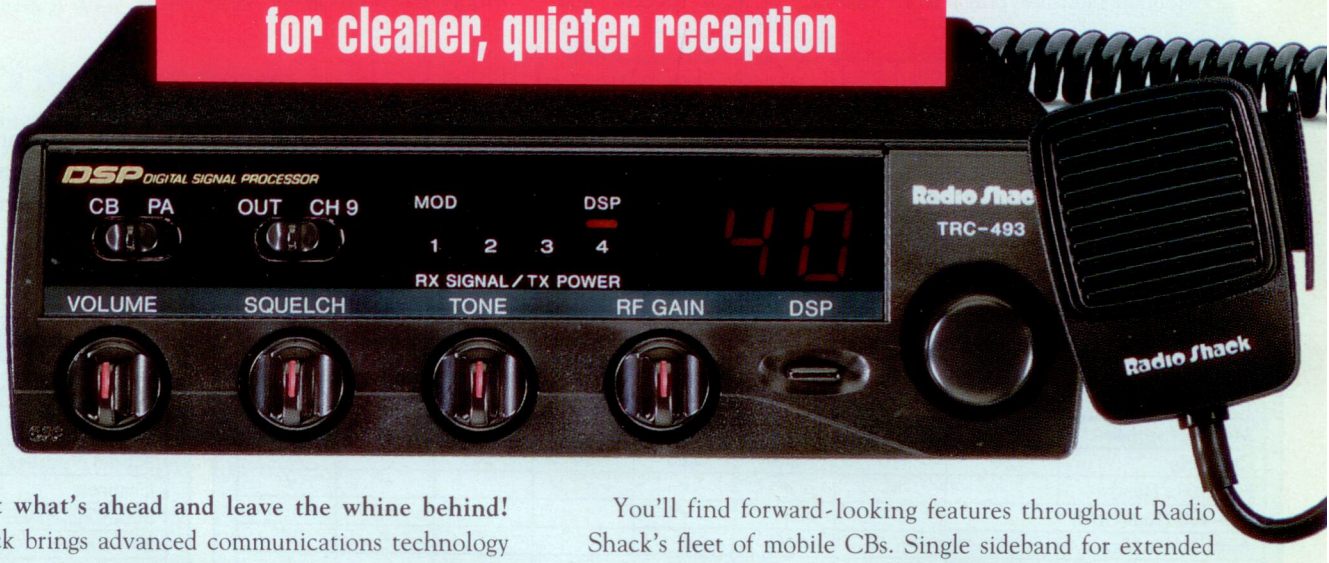
I helped clarify the orientation of the transistor leads. It seemed that the resistors, capacitors, diodes, and coils presented no problem, because somehow they had the right number of leads (two) for a young person to deal with. When we came to transistors, identifying the base, emitter, and collector was a little confusing, and I had to have my young scientists check their instructions a second time. None of the three builders stopped for so much as a drink of water, and you might see an untouched piece of cake in one of the photos—that's "Adam, the Dedicated." Next time, I'll schedule a break halfway through the construction.

If I had it to do over—and I will—I would start a little earlier in the evening, and probably not on a school night, because I can't imagine these kids going home and not staying up all night listening to the radios they built. A first-time kit-builder should allow about three hours from start to finish, and it's something that should be started right after the supper dishes are cleared away. Saturdays and Sundays will also work nicely. If you want to help more than I did, find some younger kids, say seven to nine-years-old, who will need you to make a connection now and then and explain a little more. Don't worry if you're not a rocket scientist—these kits are made for people who are willing to read and follow some very clear directions. If you're willing, you're able.

I'm already making plans to do this again. If you have a child at home (or some grandchildren), get a radio kit and create a memory for both of you. If you don't have any kids handy, spend the price of a pizza on a radio kit and invite the neighbor kid in to build it. The memories will last longer than the heartburn from the pepperoni. If you've got a Scout group, church group, or any other bunch of kids—give this a try. You'll enjoy it as much as they do, and it sure beats another trip to the National Museum of Dusty Old Stuff.

Enjoy Family Vacations Without That Annoying Whining

Radio Shack's mobile CB with DSP eliminates whines and whistles for cleaner, quieter reception



Find out what's ahead and leave the whine behind! Radio Shack brings advanced communications technology to the Citizens Band in the TRC-493 2-way radio. *Digital Signal Processing* (DSP) removes the annoying whines and whistles often heard on busy CB channels and dramatically reduces noise to boost intelligibility. The result? Clean, quiet reception that's easy on your ears.

You'll find forward-looking features throughout Radio Shack's fleet of mobile CBs. Single sideband for extended talk range. Weather band for instant updates. Even a full-power, 40-channel model priced less than $50 every day.

Radio Shack is out in front with the best-selling CBs in the USA, plus hundreds of accessories and helpful answers to your questions. Travel with the best—come in today!

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Radio Shack Highlights

Products

The HTX-212 Two-Meter Mobile Transceiver (Catalog #19-1125)

The Radio Shack HXT-212 Two-Meter Mobile Transceiver is the latest addition to Radio Shack's growing line of high-quality amateur radio equipment. It offers the most advanced, and most wanted, features available in a mobile transceiver.

The transceiver includes a new tracking tuning system feature that dramatically cuts interference from paging systems and other high power signals that lie just outside the 2-meter band.

The HTX-212 also offers true FM modulation for a clean, more natural-sounding voice signal and better packet radio performance. There are 30 memory channels and one calling channel. The priority Memory Channel automatically checks the channel and issues an alert if there is any activity.

Other features include individual programmable repeater offsets; built-in subaudible (CTCSS) tone encoder and decoder; DTMF page with group calling; programmable frequency step for tuning or scanning to 5, 10, 12.5, 20, 25, 50, or 100 kHz; extended band coverage from 136 to 174 MHz receive; and extended transmit coverage to include MARS (Military Amateur Radio Service) and CAP (Civil Air Patrol) frequencies.

The HTX-212 has selectable 45-watt and 10-watt power settings for effective communications.

Suggested retail price: $349.99

Products-At-A-Glance

The following charts are intended to give you a quick reference source for products you're interested in.

For instance, if you're looking for a handheld scanner, use the handy specification chart below. It offers the basic information you'll want to know, like number of channels offered, frequency coverage, and priority channel. You'll also find similar information in the charts for mobile scanners, home scanners, and shortwave receivers.

Handheld Scanners from Radio Shack

Model Number	PRO-23	PRO-24	PRO-25	PRO-43	PRO-49	PRO-50	PRO-51	PRO-62
Channels	50	16	200	200	10	20	200	200
800-MHz Band	✓	✓	✓	✓			✓	✓
200-400 Ham/Gov't			✓	✓			✓	
Aircraft/Air Nav	✓		✓	✓			✓	✓
Hyperscan			✓	✓			✓	✓
Search/Scan Rates	16/12	--/10	50/25	50/25	--/10	16/16	100/50	50/25
Priority Channel	✓		✓	✓	✓	✓	✓	✓
Instant Weather		✓			✓	✓	✓	
Memory Backup	✓	✓	✓	✓	✓	✓	✓	✓
Scan-Delay	auto	auto	✓	✓	auto	✓	✓	✓
Frequency Coverage (MHz)	108-137 137-174 406-512 806-824 806-896	29-54 137-174 406-512 806-823 851-868 896-1125	30-54 108-136 137-174 380-512 806-960	30-54 118-174 220-512 806-823 851-868 896-999	29-50 50-54 137-144 144-148 148-174 406-512	30-54 137-174 380-450 450-470 470-512	29-54 108-137 137-174 406-512 806-956	30-54 118-136 137-174 380-512 806-823 849-960

Mobile Scanners from Radio Shack

Model Number	PRO-2026
Channels	50
800-MHz Band	✓
200-400 Ham/Gov't	
Aircraft/Air Nav.	✓
Hyperscan	
Search/Scan Rates	16/16
Priority Channel	✓
Instant Weather	
Memory Backup	
Scan-Delay	✓
Frequency Coverage (MHz)	30-50 50-54 137-174 380-470 470-512

They've got questions.

We've got answers.

How does a radio work? Taking one apart isn't the best answer. It's really more fun to put one together.

Kids have a natural curiosity—about everything. At Radio Shack we know that building something—like a radio—can be a lot more fun than just reading about it. That's why we offer Science Fair Kits that let kids create and experiment with the things they have questions about, and some things they haven't thought of yet. Some have literally hundreds of projects, and all use battery power, not electricity, so they're fun, educational and **safe**!

Kids have questions. Radio Shack can help them find answers.

Radio Shack®

You've got questions. We've got answers.℠

Home Scanners from Radio Shack

Model Number	PRO-508	PRO-2030	PRO-2033	PRO-2034	PRO-2035	PRO-2036	PRO-2037	PRO-2038	PRO-2039
Channels	20	80	10	80	1000	100	100	50	200
800-MHz Band		✓			✓	✓	✓	✓	✓
200-400 Ham/Gov't					✓				
Aircraft/Air Nav.		✓		✓	✓	✓	✓	✓	✓
Hyperscan		✓			✓	✓	✓	✓	✓
Rotary Tuning					✓	✓			
Search/Scan Rates	16/16	50/50	--/12	16/12	50/13	200/20	200/8	--/30	50/25
Priority Channel		✓		✓	✓	✓	✓		✓
Instant Weather		✓	✓	✓	✓	✓			
Memory Backup	✓	✓	✓	✓	✓	✓	✓	✓	✓
Scan-Delay	✓	auto	✓	✓	✓	✓	✓	auto	✓
Frequency Coverage (MHz)	30-50 50-54 137-174 380-470 470-512	29-54 108-174 380-512 806-823 851-868 896-956	137-144 144-148 148-174 406-512	29-50 50-54 108-137 137-144 144-148 148-174 406-512	29-54 108-137 137-174 406-512 806-824 851-869 896-1125	30-54 108-137 137-174 380-512 806-960	30-54 108-137 137-174 380-512 806-960	30-54 108-137 137-174 380-450 450-512 806-960	30-54 108-137 137-174 380-450 450-512 806-960

Shortwave Receivers from Radio Shack

Model Number	DX-392*	DX-390	DX-375	DX-351	DX-350
Digital/Analog	Digital	Digital	Digital	Analog	Analog
Dual-Time	✓	✓			
AM/FM Stereo**	✓	✓	✓		
Direct Access Tuning	✓	✓	✓		
Manual Tuning	✓	✓	✓	✓	✓
Memory Tuning	✓	✓	✓		
Scan Tuning	✓	✓	✓		
BFO Controls	SSB/CW	✓			
Sleep Timer/Alarm	ST/A	ST/A	ST		
Headphone Jack	✓	✓	✓	✓	✓
Memory Backup	✓	✓	✓		
Weight	3.7 lbs.	3.8 lbs.	18 oz.	7.56 oz.	14 oz.
Power***	4 "D"	4 "D"	2 "C"	2 "AA"	4 "AA"
Frequency Coverage	87.5-108 MHz 150-519 kHz 520-1710 kHz 1.711-29.99 MHz	87.5-108.1 MHz 150-519 kHz 520-1710 kHz 1.711-29.9 MHz	87.5-108.1 MHz 530-1710 kHz 2300-6250 kHz 7100-21850 kHz	88-108.1 MHz 150-280 kHz 530-1710 kHz 4.60 -21.95 MHz	88-108.1 MHz 150-280 kHz 530-1710 kHz 4.60-21.95 MHz

*** Includes built-in cassette recorder**
**** Stereo with headphones only**
***** AC/DC Power Adapter Optional**

All-Pro Wide Receiver

1000-channel memory
Provides quick access to your favorite frequencies

Coverage to 1300 MHz
Tunes CB, military, government, satellite, Ham and other bands not accessible on many scanners

Rotary tuning
Great for exploring the bands—tunes just like a commercial receiver

HyperScan™
Scans and searches at a quick 50 channels per second

VHF and UHF air bands
Total coverage of civilian and military aviation communications

Triple-conversion receiver
Puts image interference out of bounds

Radio Shack's new PRO-2035 scanning receiver brings you action radio at its best. Thanks to extrawide frequency coverage and NFM/WFM/AM modes, PRO-2035 catches communications other scanners miss—police and emergency teams *plus* military aircraft, satellites, 33 and 23cm amateur radio, wireless mikes, studio-transmitter links, Citizens Band, TV audio, FM broadcasts and more.

Unlike most scanners, PRO-2035 features both rotary *and* auto-search tuning, plus 50-channel-per-second HyperScan—essential for monitoring trunked 800MHz police/fire systems. And the triple-conversion design means you'll enjoy clear reception in situations that sideline other scanners.

Feature-packed and easy to use, PRO-2035 is in a league by itself. Hear it today at Radio Shack.

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You've got questions. We've got answers.℠

Blink . . . and you just might miss it.
It's the new PRO-51—Radio Shack's fastest handheld scanner ever, with 200 channels, 800 MHz and HyperScan™.
PRO-51 scans at a blazing 50 channels per second and searches at 100 per second. And with frequency ranges for air, fire, marine and weather services *preprogrammed*, you can search those bands even if you don't know frequencies for your area!
PRO-51 has priority, lockout and scan-delay. Backlit LCD display. Even a 3-day memory backup if power's lost.
You can see PRO-51 at Radio Shack today. Better hurry, though—it's sure to go *fast!*
VRROOOM!
SCAN
MANUAL
BAND
PROG
PRI
MONI
L/OUT
CLEAR
K/L
LIGHT
AIR 1~20
FIRE 21~40
MARINE 41~60
WX 61~80
81~100
101~120
121~140
141~160
161~180
181~200
DELAY
LIMIT
ENTER
Radio Shack
200 CHANNEL DIRECT ENTRY PROGRAMMABLE SCANNER
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You've got questions. We've got answers.℠
The other guys have a lot of catching up to do.